SOUTH CAROLINA

DEPARTMENT OF TRANSPORATION

PRECONSTRUCTION SURVEY MANUAL

PRECONSTRUCTION SURVEYING PROCEDURES AND STANDARDS FOR ENGINEERING & DESIGN

Revised October, 2012

PREFACE

This *Preconstruction Survey Manual* has been developed as a guide to provide uniform design practices for Department and consultant personnel conducting surveys and aerial mapping for Department projects. Many of these standards are intended to mirror the standards found in the **Standards of Practice Manual for Surveying in South Carolina** and **Chapter 5** of the **Federal Highway Administration's Project Development and Design Manual.** The designer/surveyor should attempt to meet all criteria and practices presented in the *Manual*.

This manual presents most of the information normally required for preparation of survey requirements for a roadway project; however, it is impossible to address every situation that the designer will encounter. Additional survey requirements are also covered in the SCDOT Highway Design Manual, which outlines certain procedures and special cases. REF: HDM AS REQUIREMENT

All surveying must meet or exceed the standards set forth in the most current revision of the Standards of Practice Manual for Surveying in South Carolina.

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1.0 SAFETY

Land Surveyors and Survey parties perform their work in many hazardous environments. SCDOT promotes safe work places and recognizes the responsibility of safety for each individual. **THE CONSULTANT IS COMPLETELY RESPONSIBLE FOR THE SAFETY PROCEDURES AND THE SAFETY OF ITS EMPLOYEES.** When working within SCDOT right of ways, perform all survey work in compliance the **Manual of Uniform Traffic Control (MUTCD**) and the **SCDOT Work Zone Safety Manual**. Surveyors should always wear Personal Protective Equipment (PPE) appropriate to their task. Common PPE are as listed below:

- Eye and Face Protection – Safety glasses, etc.
- Foot Protection – Safety-Toed footwear in construction zones
- Hand Protection
- Head Protection – Hard Hats
- Hearing Protection - Earplugs

The **Occupational Safety and Health Administration (OSHA)** has many informative publications available on their website, www.osha.gov. The following are a few suggestions for maintaining a safe surveying work place:

- In the event of a serious accident or injury – call 911 immediately, then follow your firm's safety procedure.
- Do not enter Confined Spaces without proper permits, training, and equipment
- Maintain a well-stocked First Aid Kit in all survey vehicles
- Maintain a fire extinguisher in all survey vehicles
- Maintain MSDS paperwork for any applicable chemicals
- Tag broken equipment and do not use.
- Obey all Motor Vehicle laws
- Wear SCDOT approved safety vest and hats

The **South Carolina Occupational Safety and Health Administration** (SCOSHA) manages and regulates the OSHA operations in South Carolina. Please visit their website, www.scosha.llronline.com for more information about state specific rules and regulations.

The **Federal Highway Administration's Project Development and Design Manual, Chapter 5A.1** contains a Code of Safe Surveying Practice that details pertinent safety procedures and practices.

For more information or questions pertaining to Work Place Safety, please contact the **SCDOT Occupational Safety and Health Department** at 803-737-1161.

2.0 AERIAL SURVEYING AND MAPPING PROCEDURES

Photogrammetry is the science and technology of obtaining reliable information about physical objects and the environment by interpreting, measuring, and recording aerial photographic imagery. The SCDOT requirements for photogrammetry shall meet the FGDC standards and requirements as outlined in “Appendix A”.

2.01 AERIAL PHOTOGRAPHY & MAPPING – GENERAL

The following are provided as general information and are subject to change, as the Department deems appropriate. It is anticipated that work to be performed, unless specified otherwise, will be required to comply with applicable provisions of the FGDC requirements.

Photo Scale 1"=__	Flight Height (ft)	Plotting Scale 1"=__	Contour Interval (ft)	Forward Model Coverage (ft)			Pixal Resolution	Ortho Scale 1"=__
50	300	10'	1	180	x	315	0.04	10
167	1002	20	1	601	x	1052	0.1	20
200	1200	20	1	720	x	1260	0.17	30
300	1800	30	1	1080	x	1890	0.25	40
400	2400	40	1	1440	x	2520	0.33	50
500	3000	50	2	1800	x	3150	0.42	70
600	3600	60	2	2160	x	3780	0.5	80

Figure 1 AERIAL SURVEY FLIGHT SCALES

2.01.01 MAPPING AND DIGITAL TERRAIN MODELS

All mapping will be furnished by the consultant as Bentley 2D or 3D design files. Planimetric features will be furnished in a 2D design file. Topographic features will be furnished in 3D design file. Both planimetric and topographic features will be placed on separate, segregated levels as specified by the Department. Terrain model data will be submitted as Bentley 3D design files with spot elevations and break lines placed on separate levels. Break lines representing the Department's edges of pavement, curb and gutter, sidewalks or raised medians will be placed on a level separate from all other break lines.

All digital files will be fully compatible with the Department's Bentley system as well as Microstation and Geopak design software. Design files shall be based on the following for English working units:

1. Design files shall be based on the following for English working units:
2. Master Units: ft
3. Sub Units: in
4. Sub Units per Master Unit: 12 in per ft.
5. Positional Units per Sub Unit: 1000 Pos. Units per in.

NOTE: For the State of South Carolina, the official conversion factor to convert meters to feet is based on the International Foot (1 meter = 3.280839895 or 1 foot = 0.304800000 meter).

The Consultant will use the Department's specified level structure and cell library.

2.02 ACCURACY REQUIREMENTS / CADD STANDARDS

a) General Photogrammetric surveys are defined as the use of photogrammetry for obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting images and patterns of electromagnetic radiant energy and other phenomena. Minimum allowable photogrammetric production procedures and standards are hereby established for photogrammetric mapping and digital data production.

b) Production procedures for photogrammetric mapping surveys shall be in accordance with the standards established by the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standard and applicable extensions and revisions. These standards are incorporated by reference including subsequent amendments and editions.

c) Topographic maps, unless clearly marked as “Preliminary Map”, shall meet FGDC Standards for horizontal and vertical accuracies. All orthophotos and planimetric maps, unless clearly marked as “Preliminary Orthophoto” or “Preliminary Map”, shall be produced to meet FGDC Standards for horizontal accuracies.

d) When the resulting product is a digital (electronic) data set, or a map or document consists of more than one sheet, a project report will be certified and signed.

e) Ground control for photogrammetric projects shall be in South Carolina Grid coordinates and distances when the project is tied to Grid.

f) The project map or report shall contain applicable following information:
   1) Date of Photography or original data acquisition
   2) Scale of Photography
   3) Date of document or data set compilation
   4) If hard copy product is produced, the maps shall contain a north arrow, map legend, final document scale and contour interval, as applicable.
   5) Coordinate system for horizontal and vertical denoting SI or English units (i.e., NAD 83, assumed, etc.)
   6) A list or note showing the control points used for the project, x, y & z.
   7) If other data is included which was obtained by means other than photogrammetry, the source and accuracy of those items must be clearly indicated.
   8) A statement of accuracy complying with FGDC standards.
   9) For topographic maps or data sets, contours in areas obscured by man-made or natural features shall be uniquely identified or enclosed by a polygon clearly identifying the obscured area. The accuracies of the contours or of the features in this obscured area should be noted to the extent they deviate from the general accuracy of the map or data set.
   10) A vicinity map depicting the project location shall appear on the first sheet of all hard copy maps or in the report accompanying digital files.
   11) Company name, address and phone number.

12) The name of the client for whom the project was conducted

g) A certificate, substantially in the following form, shall be affixed to all maps or reports (See sample report):
"I, _____, certify that this project was completed under my direct and responsible charge from an actual photogrammetric survey made under my supervision: that this photogrammetric survey was performed to meet Federal Geographic Data Committee Standards as applicable; that the imagery and/or original data was obtained on _____; that the photogrammetric survey was completed on _____; that contours shown as [broken lines] may not meet the stated standard; and all coordinates are based on _____.

h) An electronic copy of any digital data set delivered to the client shall be retained in the permanent files of the licensee.

2.03 CAMERA REQUIREMENTS/CALIBRATION REPORT

a) The aircraft shall be equipped with a precise aerial camera fitted with a 6" focal length and Forward Motion Compensation (FMC).
b) The photography shall be flown at 60% forward overlap and shall not contain any excessive tip, tilt, crab or cloud cover.
c) In areas where water bodies are under tidal influence, aerial photography shall be acquired within a time not to vary by more than 2 hours from the time of low tide.
d) Aerial photography shall be obtained when shadows are smallest and when the suns inclination angle is greater than 30°.
e) A current calibration report shall be supplied to the SCDOT.

2.04 AERIAL TRIANGULATION REPORT AND CERTIFICATION

The consultant shall use analytical aerotriangulation methods and procedures to extend and densify the ground control provided and establish the photo control required for photogrammetric map compilation as follows:

- The analytical computations must result in a minimum root mean square (rms) error at the control points of one part in ten thousand (1:10,000) of the flight height (AMGL).

- A minimum of nine precisely marked supplemental control points shall be established for each photograph, with six points located as near as possible to the corners and nadir point of the neat model.

- All point marking of the film diapositives shall be accomplished using precision point transfer devices. All marks shall be drilled clearly through the emulsion of the diapositive, and excess waste material shall be removed carefully from the surface prior to the mensuration operation.

- The locations of the supplemental and ground control points shall be measured using fully analytical instruments.

- The computer software used shall contain a fully analytical block aerotriangulation program, and shall incorporate the capability to give appropriate weight factors to the control points on an individual basis, and to correct for film deformation, atmospheric refraction, Earth curvature and lens distortion.

- Prior to the commencement of photogrammetric map compilation, the Consultant shall submit to SCDOT a Control Report detailing the results of the analytical aerotriangulation in the project area.

2.05 ORTHOPHOTO FILES

Digital orthophotos shall be developed from a perspective aerial photograph by differential rectification methods so that image displacements caused by camera tilt and terrain relief are removed.

Aerial negatives or diapositives shall be scanned using a precise image scanner. DTM or DEM may be used to rectify the images depending on the scope of the project by SCDOT.

The resampling of intensity values from the input image to the output one shall be accomplished using cubic algorithm or equivalent.

In case of multiple images, a mosaic shall be produced and image quality shall be uniform. All deliverables are to be in Tiff format accompanied by a TFW header.

2.06 QA/QC

The first QA/QC step is to ensure that the triangles and contours generated by GEOPAK Tin Match the ones provided by the mapper.

The second QA/QC step is to ensure that the DTM accurately represents the terrain. One way of checking this is to process a profile and association for a known baseline. Ensure that the profile on the centerline of the roadway and edge of pavement collected during the field surveys conducted during the mapping phase are accurately reflected in the Tin generated from the compiled DTM.

2.07 AERIAL MAPPING DELIVERABLES

Preconstruction Surveying Consultants will deliver to the DOT files that are compatible with the Departments CADD and Plan Development Process. All Roadway Project within the Department are assigned a Project Pin Number. All files submitted by the Consultant will be referenced to a Project Identification Number (PIN). The types of files and naming conventions are listed below and are examples of some of the files that might be requested by the Department. The examples shown assume a PIN of 123456.

123456.txt	ASCII comma delineated file of survey points.
123456.dgn	2D Microstation file containing all planimetric mapping.
123456dtm.dgn	3D Microstation file with all breaklines, spot elevations, triangulation and contours.
123456op.tif	Tiff format file containing the orthophoto files.
123456op.tifw	Geographic world file.

Note: Any additional surveys submitted for the same project will follow the same naming convention but will add an A, B, C, etc. Example: for the first additional survey the file name will be 123456a.new, the second additional survey will be 123456b.new etc.

* Other deliverables such as calibration report, aerial triangulation report will be submitted prior to commencing the mapping process. The photogrammetric certification project report should also be signed and certified by the responsible charge supervisor.

3.0 PRECONSTRUCTION SURVEY GUIDELINES

A South Carolina Registered Land Surveyor will be required to be directly responsible for the proper execution of the surveying work to be performed. The scope of the surveying work to be performed will be determined by the requirements for the design of the project and preparation of the right of way and detailed construction plans. The following is provided as supplemental information to other SCDOT requirements for the design and development of the project.

3.01 PRECONSTRUCTION SURVEY ELEMENTS

Project engineers will analyze projects in depth to determine the exact survey needs accurately illustrate the proposed improvements on the final Construction Plans. Considerations for the type of facilities being planned for improvements and the types of surveys required to achieve the project objective. The following chart depicts the typical work flow for a preconstruction survey:

Figure 3 SURVEY WORKFLOW

The following is a list of survey tasks that may be required for a specific roadway project:

Public Notification (section 3.02)

Geometric Planning (section 3.03) Determine the best surveying methodology.

Aerial Surveys (section 3.04)

Project Survey Control (section 3.05) Establish survey control points and benchmarks.

Pavement DTMs (section 3.06) - All roadway features (edge of pavement/concrete, travel lanes, breakpoints, crown, etc.) will be located linearly to be used topographically and planimmetricaly.

Drainage Surveys (section 3.07) - All outfall ditches will be located with break-lines a minimum of 400' from roadway.

Horizontal / Best Fit Alignment Surveys (section 3.08) - Establish existing roadway centerlines and/or proposed or realigned centerlines.

Property and Right of Way Surveys (section 3.09) - Establish existing right of way lines and locations. Depicts reputed private property sidelines that abut existing right of ways.

Bridge / Culvert Surveys (section 3.10) - Identify specific elements of existing and/or proposed bridges.

Railroad Surveys (section 3.11) - Identify specific elements along an existing railroad corridor.

Planimetric Surveys (section 3.12) - Identify and locate cultural and natural topographic features (trees, buildings, sidewalks, etc.)

Topographic Surveys (section 3.13) - Locates the three dimensional ground topography within project limits.

Subsurface Utility Engineering (SUE) (section 3.14) - Surveys that identify the precise location of above and underground utility facilities.

Environmental Surveys (section 3.15) - Surveys that identify specific locations and boundaries which impact roadway designs (archeological sites, historic sites, wetland, floodway, wildlife protected areas, etc.)

Right of Way Staking, Monuments, and Plats (section 3.16)

QA-QC & Ground Tests (section 3.17)

3.02 PUBLIC NOTIFICATION

No survey work is to be performed on property from which right of way may be acquired without providing a public notification. This is to be done in accordance with the requirements of the Eminent Domain Procedures Act for the State of South Carolina. Other means of notification are needed if the work to be performed will be in areas that may cause concerns for security to residents and property owners.

3.03 GEOMETRIC PLANNING

The proposed survey limits will be analyzed to determine the most efficient methodology of collecting the required survey data. Usually, determination can be achieved through the use of available mapping (county aerials, USGS Quads, etc.) and existing roadway plans.

After the survey methods are determined, geometrically lay out the survey control network to achieve maximum accuracies. All survey control points will be located in safe and accessible locations. Primary Survey Control should be set out of the proposed construction area. All survey control points will be set within sight-able distance and view with another survey control point and should be evenly spaced throughout the project area. Survey Control Networks should be traversable within reason.

3.04 AERIAL PHOTOGRAPHY AND MAPPING

The general requirements for aerial photography and mapping from photography are provided in Chapter 1. The Preconstruction Surveys Engineer or the Assistant Preconstruction Surveys Engineer must approve any modifications.

Any mapping derived from aerial photography will be supplemented by ground surveying to insure that the mapping will provide sufficient information, detail, and accuracy needed for the project's design and development.

3.05 PROJECT SURVEY CONTROL

The surveying requirements for the horizontal and vertical control are provided below. Many of these standards are intended to mirror the standards found in the Standards of Practice Manual for Surveying in South Carolina and Chapter 5 of the Federal Highway Administration's Project Development and Design Manual. These requirements may be modified if warranted by project conditions. The Preconstruction Surveys Engineer or the Assistant Preconstruction Surveys Engineer must approve any modifications.

3.05.01 SURVEY CONTROL COMPONENTS

Survey Control will consist of Primary Survey Control (PSC), Main Survey Control (MSC) and Secondary Survey Control (SSC). The main aspects of the different Survey Control are as follows:

- Primary Survey Control (PSC)
  - Positional coordinates are derived solely from extraterrestrial GPS observation.
  - PSC will be set in Azimuth Pairs at
    - The beginning and end of projects
    - Spaced appropriately according to project length and Survey Control Class
- Main Survey Control (MSC)
  - Positional coordinates may be derived from terrestrial or extraterrestrial observations
  - Will be spaced no more than 1,450 ft. apart
  - Will be inter-visible with at least two other MSC or PSC
- Secondary Survey Control (SSC)
  - Positional coordinates derived from PSC or MSC
  - Will be considered Temporary

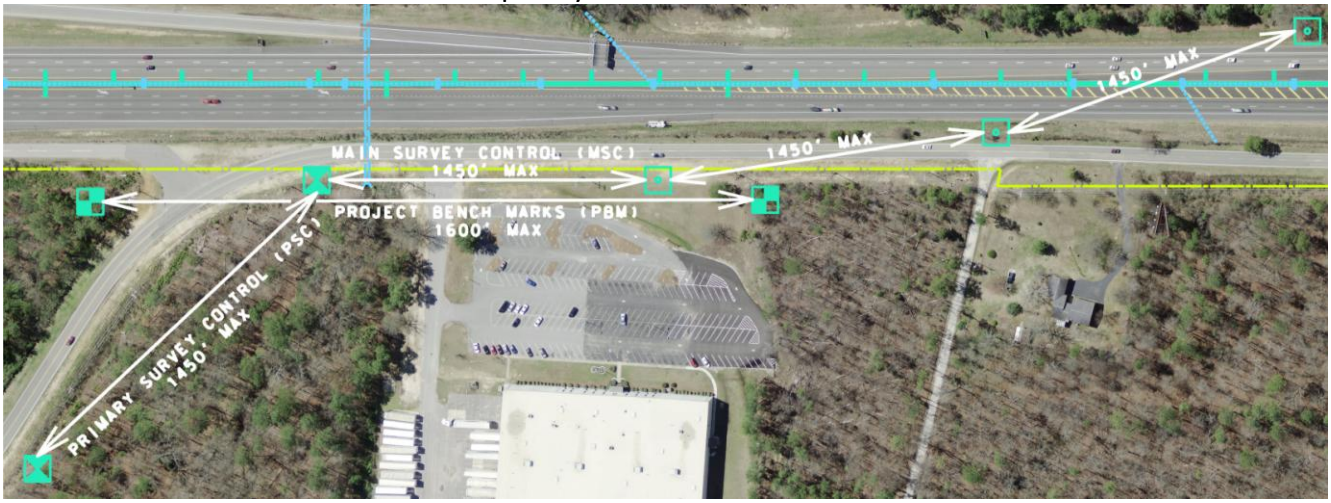


Figure 5 PROJECT CONTROL LAYOUT

All PSC points will be #5 rebar, at least 18” long, with a 2” dia. aluminum cap and set approximately flush ground. The aluminum cap should show the Project Control Number (PCN) and PSC point number. PSC points should be marked by a witness stake with pink flagging.

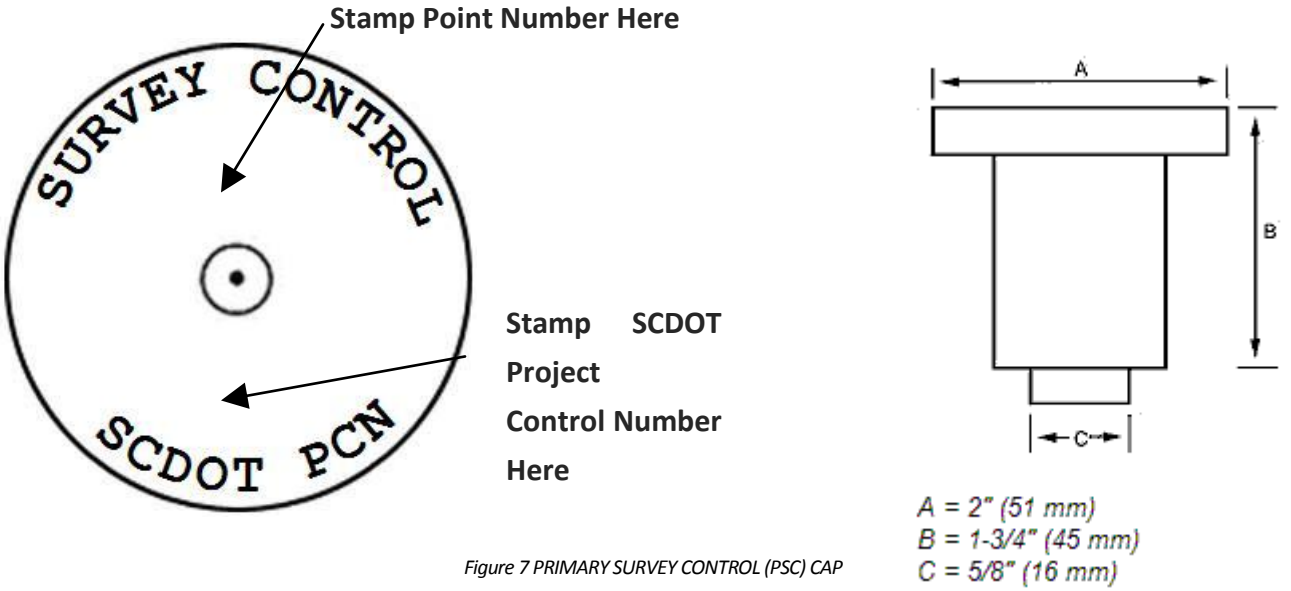


Figure 7 PRIMARY SURVEY CONTROL (PSC) CAP

3.05.02 PRIMARY AND MAIN SURVEY CONTROL DATUM REFERENCES

Coordinate values should be in the South Carolina State Plane Coordinate System or Geographic Positions based on the National Coordinate System. Horizontal coordinate values should be in the North American Datum of 1983 (NAD 83) NSR 2007 or the most current datum published by the National Geodetic Survey (NGS). Vertical coordinate values should be in the North American Vertical Datum of 1988 (NAVD 88) or the most current datum published by the National Geodetic Survey (NGS). If coordinates are not referenced to the National Coordinate System, identify the local coordinate system used and its relationship to the National Coordinate System. Coordinates shall be given in either metric or English units. The English unit in South Carolina is the international foot. (State of South Carolina)

3.05.03 HORIZONTAL CONTROL ACCURACY

The National Geodetic Survey no longer publishes relative accuracies such as first, second or third order. Instead, accuracies are now published as relative network positional accuracy stated at the 95% confidence level. These positional accuracies are in complete agreement with the Federal Geographic Data Committee. (State of South Carolina)

The relative horizontal accuracy of the PSC / MSC Control Network should meet the accuracy

standards for a **Class A Urban Survey** and described in the Standards of Practice Manual for Surveying in South Carolina. Those requirements are as follows:

Terrestrial (Ground) Survey
Minimum Unadjusted Closure - 1:10,000
Maximum Angular Closure - 15”√Number of Points in Traverse
Extraterrestrial (GPS) Survey
Relative Positional Accuracy - 0.07’+50PPM or 0.07’+1/20,000xPerimeter

Figure 9 SURVEY CONTROL ACCURACY REQUIREMENTS

The Survey Control Network Relative Accuracy should meet the standards as published by the FHWA. The majority of surveying projects will requirement FLH Class B accuracies for the PSC/MSC.

FLH Class	PT Series	Type of Survey	95% Probability Circle
A	2000	GPS	0.06 ft
B	3000 / 5000	Primary (Terrestrial or GPS)	0.10 ft
C	4000	Secondary (Terrestrial or GPS)	0.25 ft
D	6000	Cadastral (Terrestrial or GPS)	0.25 ft
E	8000	Wing Points (Terrestrial or GPS)	0.30 ft

Figure 11 FHWA POSITIONAL ACCURACY CHART

The following chart details the methodology for achieving accuracy requirements as published by the FHWA:

PT Series	Points	Rejection Limit	Stations Between Checks	Reciprocal Zeniths	Traverse
3000	3D / 3R	6" from Mean	12 between Known (GPS)	3D / 3R, 10" from Mean	On Known (GPS)
4000	2D / 2R	8" from Mean	20 between Known (GPS)	1D / 1R forward & back	On Known (GPS)
8000	1D / 1R	5" from Mean	n/a	forward & back	Open OK

Figure 13 FHWA TERRESTRIAL SURVEY METHODOLOGY CHART

3.05.04 SURVEYING WITH THE SOUTH CAROLINA REAL TIME NETWORK

SCDOT partnered with the South Carolina Geodetic Survey Department (SCGS) in developing the statewide GPS Real Time Network (RTN) The minimum accuracy standards listed below is referenced the **MANUAL FOR THE PRACTICE OF LAND SURVEYING IN SOUTH CAROLINA.**

Type	Relative Accuracy (95%)	Max PDOP	Min # of Satellites	Site Calibration
Static GNSS	0.07' + 1:50,000	5	4	N
Property Corner Positions	0.07' + 1:20,000	5	4	N
RTK GNSS	0.07' + 1PPM dist from Base	3	5	Y
RTN (VRS) GNSS	0.07'	3	5	N

Figure 15 SC GPS POSITIONAL ACCURACY CHART

All the above Geodetic Surveys will achieve the required minimum accuracy for Land Surveys. (State of South Carolina)

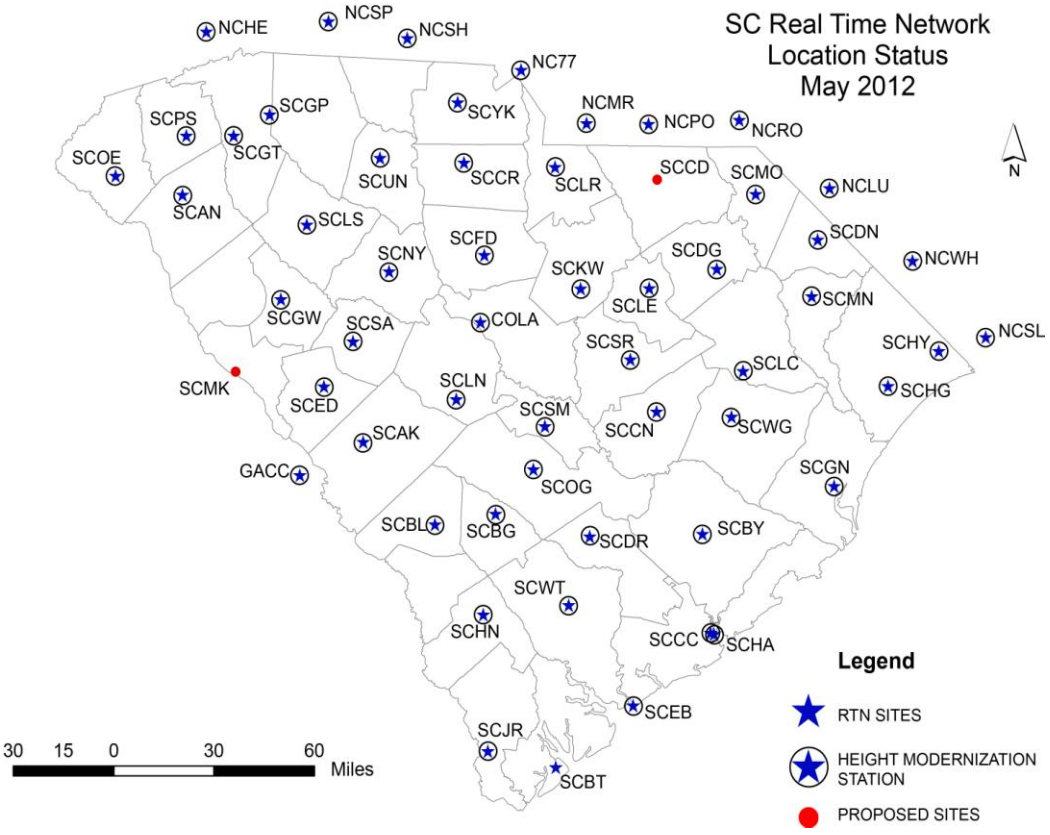


Figure 17 RTN MAP, 2011

3.05.04.01 NAD83 (2007)

Below is a map showing the horizontal shift in coordinate values from the older version of NAD83 (COR96) and the current adjustment of NSR2007. (National Geodetic Survey)

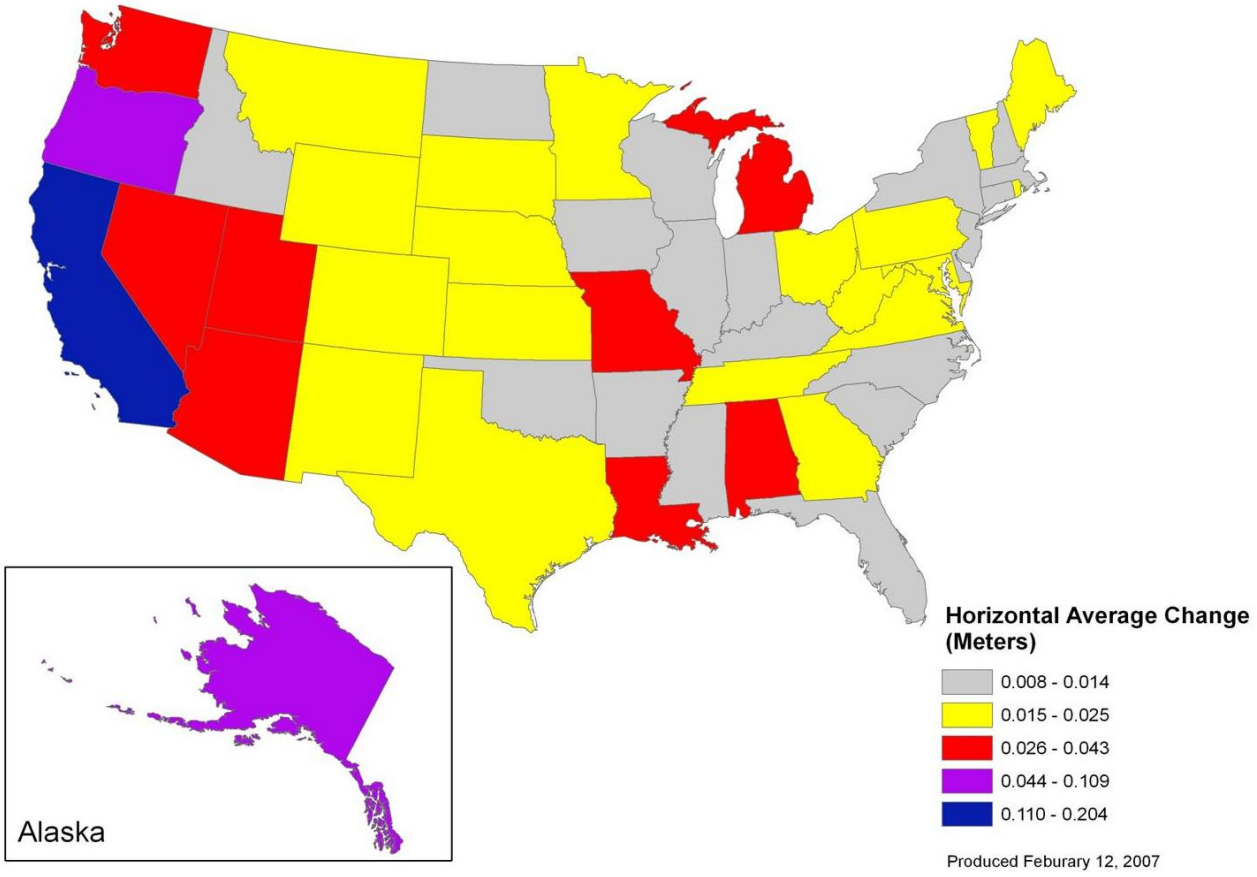


Figure 19 NAD83 (NSR2007) MAP

NSR2007 data is available on the NGS marker Datasheets and is recognizable in the highlighted example below:

```
DE2152 ***********************************************************************
 DE2152  DESIGNATION -  10 SL
 DE2152  PID         -  DE2152
 DE2152  STATE/COUNTY-  SC/LEXINGTON
 DE2152  USGS QUAD   -  POND BRANCH (1986)
 DE2152
 DE2152                        *CURRENT SURVEY CONTROL
 DE2152  ______________________________________________________________________
DE2152* NAD 83(2007)-  33 43 59.20799(N)     081 13 15.37614(W)      ADJUSTED
 DE2152* NAVD 88     -       148.9     (meters)      489.      (feet)  VERTCON
 DE2152  ______________________________________________________________________
 DE2152  EPOCH DATE  -        2002.00
```

3.05.05 VERTICAL CONTROL – PROJECT BENCHMARKS (PBM)

Elevation benchmarks will be established at intervals ranging from 1,000 feet not to exceed 1,600 feet {English} or 487 meters {Metric} near the project alignments or baselines. Level readings for benchmarks will be to the hundredth of a foot (0.01) {English} or to the millimeter (0.001) {Metric}.

The maximum allowable error of closure for English unit surveys is 0.05 foot multiplied by the square root of the length of the level run in miles. The maximum allowable error of closure for Metric unit surveys is 12 millimeters multiplied by the square root of the length of the level run in kilometers.

The elevations will be tied to a minimum of one vertical benchmark in the National Geodetic Control Network that is classified with appropriate published vertical accuracy. Further ties will be made to all National Geodetic Control Network benchmarks in the vicinity of the project that can be recovered.

The North American Vertical Datum of 1988 (NAVD 88) will be used unless otherwise specified. Any data that might be used from any previous projects must be verified for accuracy and vertical datum. Historically, some projects have been oriented to the National Geodetic Vertical Datum of 1929 (NGVD29) and some to assumed datum.

In addition to other requirements that may be specified under the SCDOT Highway Design Manual, a table will be provided within the design and construction plans, which lists all benchmarks set for the project. This table will state the vertical datum. For each benchmark, the following will be provided: an approximate northing and easting, an alignment or baseline station and offset reference, elevation, and description of the mark. Additionally, all elevations for National Geodetic Control Network benchmarks tied to will be documented.

3.05.06 DOCUMENTATION OF PSC, MSC, AND PBM

A full sized plan sheet will be prepared showing a Project Datum Description, tabulated list of PSCs and MSCs, an appropriate to the Datum Description, a tabulated list of PBMS, and a Surveyor's Certificate in addition to the requirements covered under the SCDOT Highway Design Manual.

3.05.06.01 DATUM DESCRIPTIONS

The coordinate systems developed for each project will be described by a **DATUM DESCRIPTION**. The **DATUM DESCRIPTION** will be one of the following types:

- GRID State Plane Coordinate System
- LOCALIZED State Plane Coordinate System
- ASSUMED Coordinate System***

GRID State Plane Coordinate System (GSPCS) Datum Descriptions will be used for projects that where the MSC coordinate values are true Grid Coordinates. A Combined Scale Factor will be applied when measuring horizontal ground distance between these points. A GSPCS Datum Description is as follows:

THE GRID COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON NAD83 (ADJUSTMENT DATA) SOUTH CAROLINA STATE PLANE COORDINATE SYSTEM. A COMBINED SCALE FACTOR FOR EACH PRIMARY SURVEY CONTROL POINT IS GIVEN AND MUST BE APPLIED TO HORIZONTAL GROUND DISTANCES. ELEVATIONS FOR THIS PROJECT ARE BASED ON NAVD88 VALUES FOR PBM NUMBER __ WITH AN ELEVATION OF 123.45'

LOCALIZED State Plane Coordinate System (LSPCS) Datum Description will be used for projects where the PSC coordinate values have been scaled from grid to reflect ground coordinates. Scale factors are not applied when measuring horizontal ground distances. The LSPCS Datum Description is as follows:

THE LOCALIZED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON THE NAD83(ADJUSTMENT DATA) SOUTH CAROLINA STATE PLANE COORDINATE FOR THE PRIMARY SURVEY CONTROL POINT NUMBER __ WITH A NORTHING OF 123456.7890 AND AN EASTING OF 1234567.8901. THE AVERAGE COMBINED SCALE FACTOR (GROUND TO GRID) IS 0.123456789. ELEVATIONS FOR THIS PROJECT ARE BASED ON NAVD88 VALUES FOR PROJECT BENCH MARK NUMBER __ WITH AN ELEVATION OF 123.45'

******ASSUMED Coordinate Systems should only be used when extending or adding to an existing project that is not tied to SCSPS. Prior approval must be obtained from the SCDOT Preconstruction Survey Office before an ASSUMED Coordinate System is used.***

ASSUMED Coordinate System (ACS) Datum Description will be used for projects that are not based on South Carolina State Plane Coordinates and reads as follows:

THIS ASSUMED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON PRIMARY SURVEY CONTROL POINT NUMBER __ WITH A FALSE NORTHING OF 10,000.00 AND A FALSE EASTING OF 50,000.00. ELEVATIONS FOR THIS PROJECT ARE BASED ON NAVD88 VALUES FOR PROJECT BENCH MARK NUMBER __ WITH AN ELEVATION OF 123.45'.

-Or-

THIS ASSUMED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON PRIMARY SURVEY CONTORL POINT NUMBER __ WITH A FALSE NORTHING OF 10,000.00 AND A FALSE EASTING OF 50,000.00. ELEVATIONS FOR THIS PROJECT ARE BASED ON ASSUMED VALUES FOR PROJECT BENCH MARK NUMBER __ WITH AN ELEVATION OF 123.45'.

3.05.06.02 SURVEY CONTROL DATA TABLES

A table for each project will include the following information for each survey control point:

PSC Control
Point Number
Station / Offset
Northing
Easting
Elevation
Description
Combined Scale Factor

MSC Control
Point Number
Station / Offset
Northing
Easting
Elevation
Description

PBM Control
Point Id Number
Station / Offset
Northing
Easting
Elevation
Description

3.05.07 SURVEY CONTROL REQUIREMENTS FOR INTERSTATE REHABILITATION

In addition to the requirements for Survey Control as described above, the Contractor shall be responsible for establishing of a Survey Control Network (SCN) for Interstate Rehabilitation and Cross Slope Verification projects in accordance with the following;

1. All survey work will be performed under the direct supervision of a register South Carolina Professional Land Surveyor and in accordance with the manual of Practice for Land Surveying in South Carolina
2. SCN will include the following:
    a. Primary Survey Control (PSC) will include the following:
        i. PSC points will be 18" #5 Rebar with a 2" aluminum cap.
        ii. Horizontal coordinates will be SCSPG NAD83 (2007 or current adjustment).
        iii. Accuracy Standards found in the SCDOT PSM
        iv. PSC pairs will be spaced no greater than 600' apart
        v. All PSC will be tied to the Vertical Control
    b. Vertical Control – Project Bench Marks (PBM) will include the following:
        i. PBM points will be a Rail Spike, preferably in a tree, out of construction zone
        ii. Vertical Datum will be NAVD88
        iii. PBMs will be referenced to the nearest Geodetic Vertical Monument
    c. Main Survey Control (MSC) will include the following:
        i. MSC points will be 8" bridge spikes or similar material
        ii. Horizontal and Vertical data established from PSC and PBM
3. Existing Horizontal Alignment (EHA) will include the following:
    a. Based on existing construction plan alignment data
    b. Best fit of existing construction plan alignment data
4. Reference Horizontal Alignments (RHA) will include the following:
    a. Based on existing roadway features as Surveyed
    b. Stationing to correspond to the EHA as much as possible
    c. Alignment Geometry will comply with the SCDOT Highway Design Manual
    d. The EHA & RHA may reflect the exact same information.
5. RHA Offset Reference Marking (ORM) will include the following:
    a. ORM methods will be conducive to project conditions and may include the following:
        I. 36" / 48" stakes marked with white flagging or paint
        II. Paint marks on barrier walls
    b. Will be marked with referenced RHA station and offset from alignment
    c. Will be set at an offset that will be safe and useful for the CEIs
    d. Will be set normal to RHA stations at the following locations;
        i. Begin & end of Superelevation (SE)
        ii. Flat Cross Slopes within SE Transitions
        iii. "Remove Crown" stations
        iv. Begin & End of maximum SE

v. Horizontal PCs & PTs

6. Survey Control Report (SCR) will contain the following information;
    a. Datum Description for the SCN
    b. Declared accuracy of the SCN
    c. Values for the PSC that includes:
        i. PSC point number
        ii. Horizontal Coordinates
        iii. Combined Scaled Factors
        iv. Elevations
    d. Values for the PBM will include the following:
        i. PBM Description including a reference number
        ii. Approximate Horizontal Coordinates
        iii. Elevation
    e. Values for the MSC that include:
        i. MSC point number
        ii. Horizontal coordinates
        iii. Elevations
    f. Coordinate Geometry for all project alignments (EHA & RHA)
    g. Surveyor Certification signed and sealed by a registered South Carolina Professional Land Surveyor

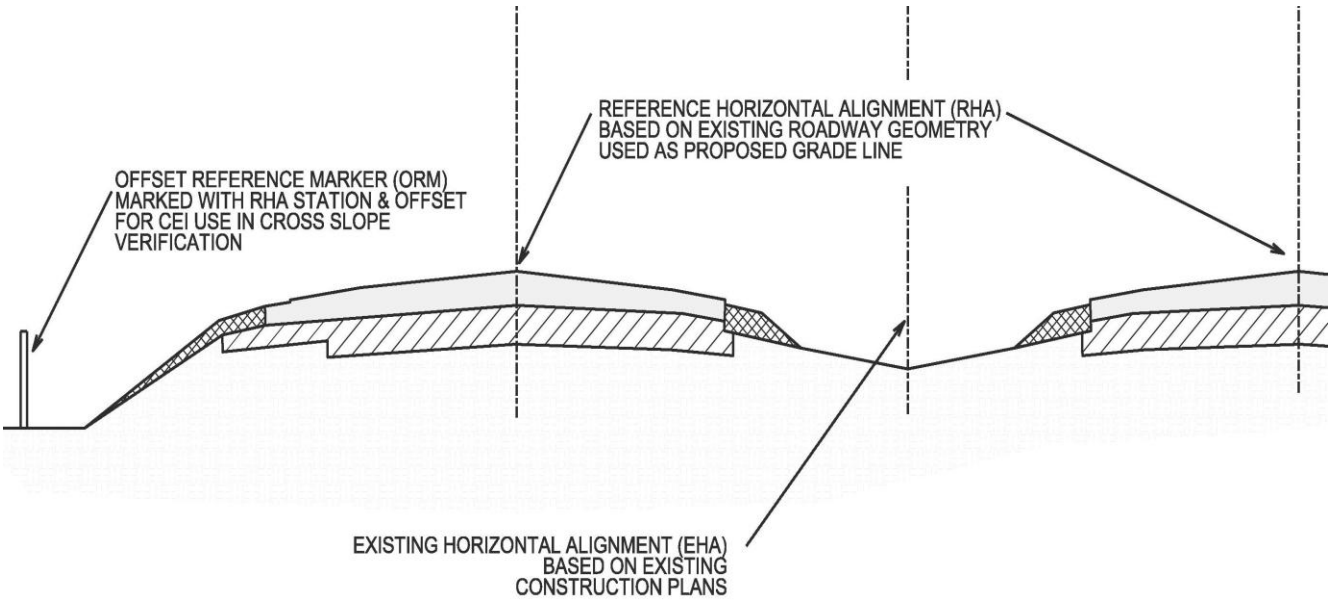


Figure 21 CROSS SLOPE VERIFICATION LAYOUT

The contractor will be responsible for the surveyed cross section data of the project in accordance with the following;

1. All survey work will be performed under the direct supervision of a registered South Carolina Professional Land Surveyor
2. All located cross section data will be collected from PSC points
3. All located cross section data will be collected from the nearest PSC point.
4. Vertical accuracy for each point along the located cross section shall be within 0.04'.

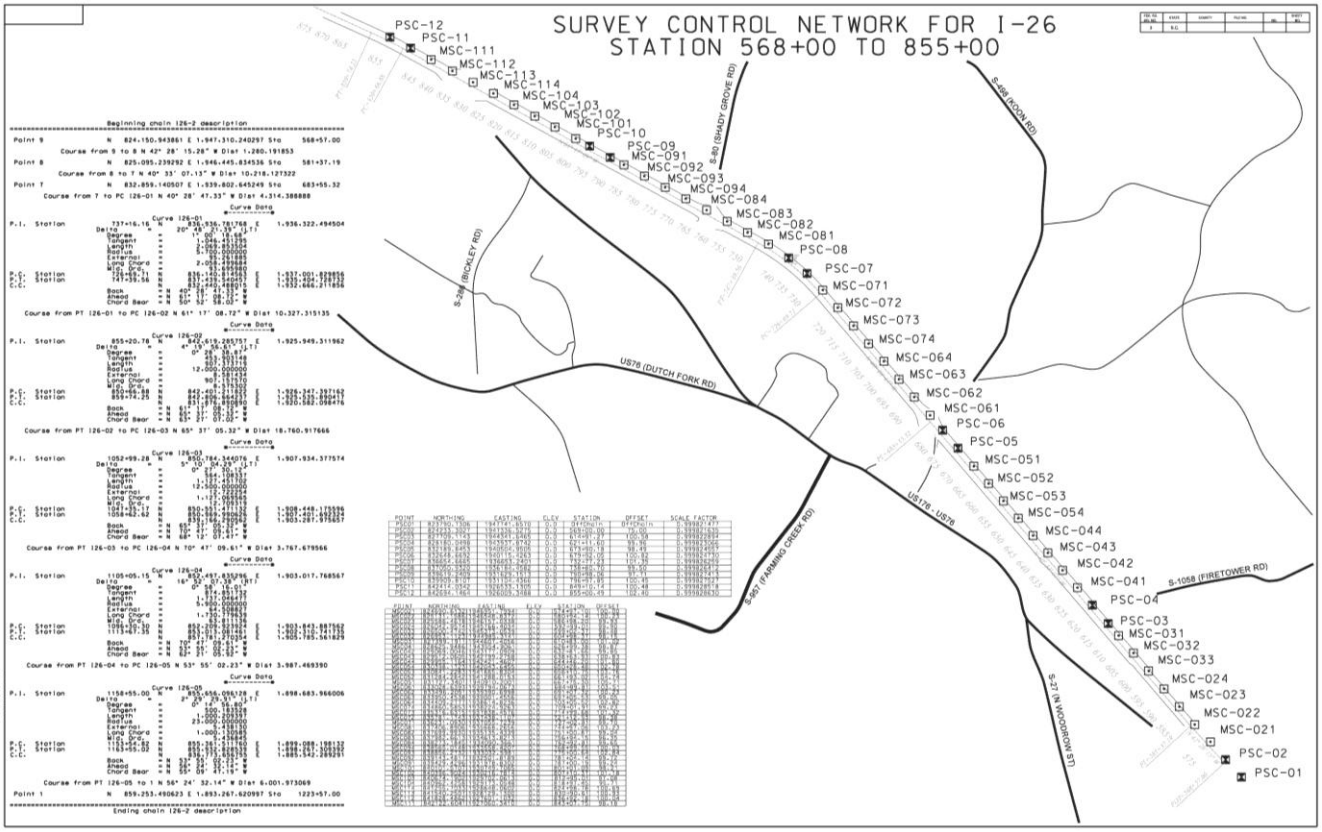


Figure 23 SURVEY CONTROL NETWORK FOR REHAB EXAMPLE MAP

The Department reserves the right to verify, at the Departments discretion, any information, data, accuracies, material, or methodology corresponding to the Survey Controls including, but not limited, to the following:

1. "Raw" data from data collection software
2. CAD files
3. Written survey notes
4. Daily work logs

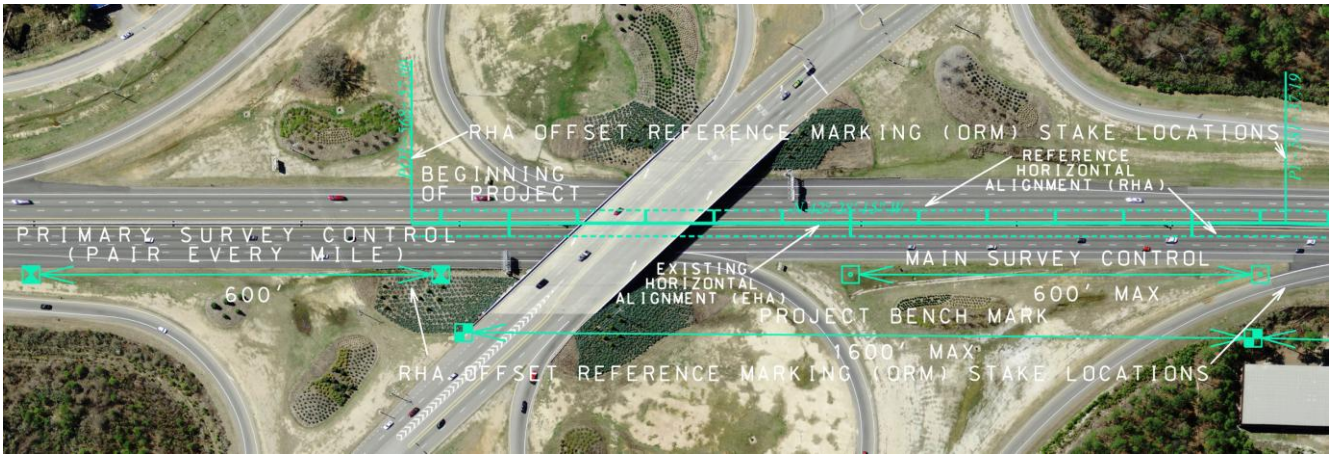


Figure 25 CROSS SLOPE VERIFICATION CONTROL

3.05.08 FINAL SURVEY REPORT

A Final Survey Report will be developed for use in the final construction plans to be included in either the Reference Data Sheet or on a Survey Control Reference Data Sheet. This report should be in a spreadsheet format like Excel and will have the following components, each on a separate worksheet or tab;

1. Datum Description - Includes one of the formats shown above in Datum Descriptions
2. Primary Survey Control – Includes data as shown above in Survey Control Data Tables
3. Project Benchmarks – Includes data as shown above in Survey Control Data Tables
4. Main Survey Control – Includes data as shown above in Survey Control Data Tables

Figure 27 Final Survey Report Spreadsheet Tabs

3.06 EXISTING ROADWAY SURVEYS / PAVEMENT DTMS

All SCDOT Safety recommendations should be followed when collecting survey data on existing roadway and when on SCDOT right of way.

Existing paved roadway surfaces will be surveyed using break-lines with surveyed points located on a cross section at predetermined station intervals. Generally most roadways cross-sections include edge of pavements and crown points. Depending on the existing roadway conditions, number of lanes, etc, more topographic points will collected. The distance between each located shot of roadway features should not exceed 50 feet.

Figure 29 HIGHWAY SURVEY EXAMPLE

In many cases, it is required to replace the existing Edge of Pavement (EP) shots/breaks with ground surveys and delete the aerial mapping EP Breaklines. Some aerial surveys are performed at low altitudes and meet accuracy requirements and will not need to be replaced.

ROADWAY LOCATIONS – CROSS SECTION VIEW

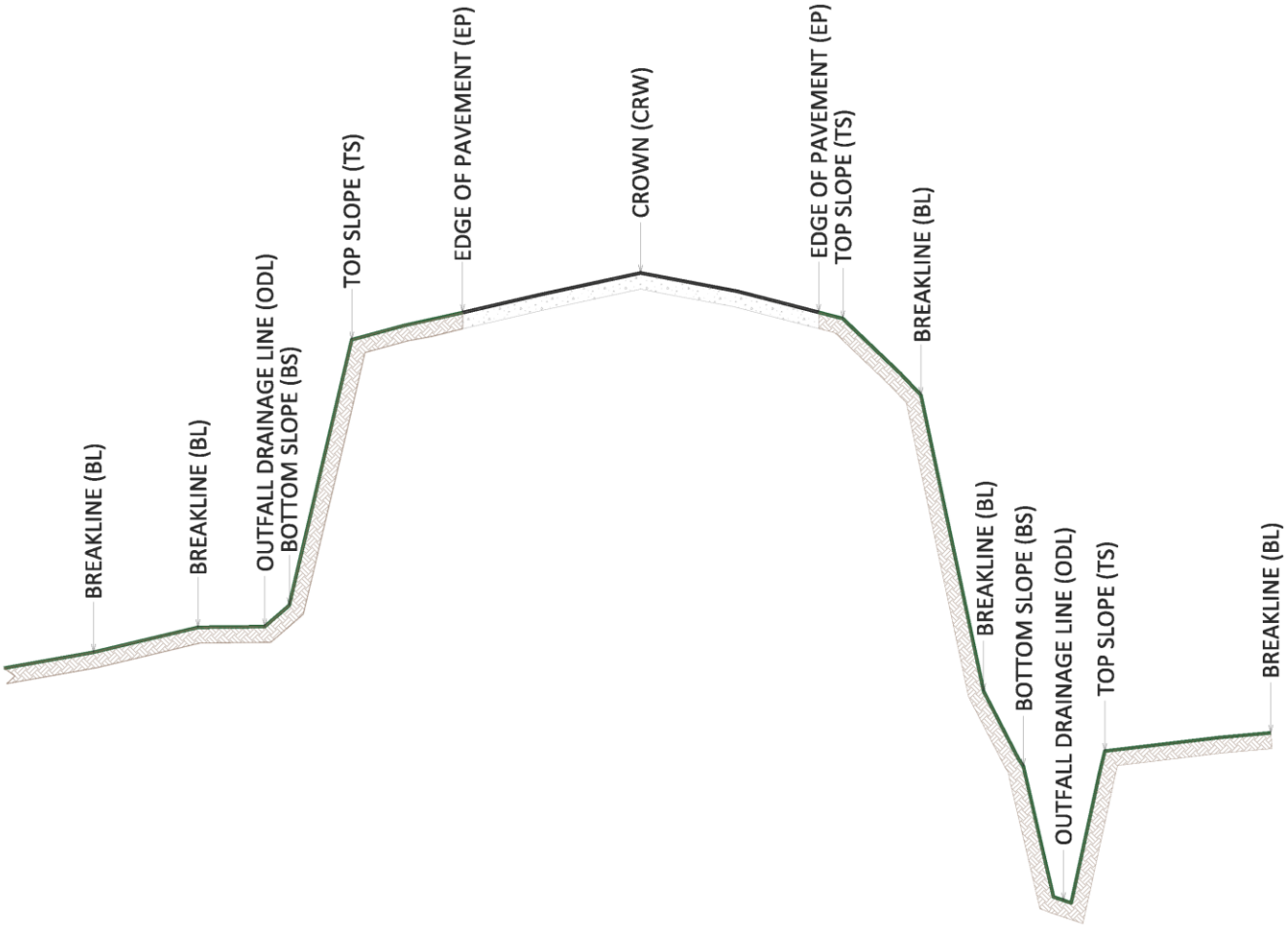


Figure 30 ROADWAY SURVEY DETAIL – CROSS SECTION

3.07 DRAINAGE SURVEYS

Rivers, Stream, Creeks, and Outfall Ditches will all be surveyed in varying distances as per project scope and engineering requirements. Drainage feature are commonly surveyed up and down-stream 400 feet as measured from the end of the drainage structure. The following are some general guidelines for locating and collecting cross section survey data.

3.07.01 OUTFALL DITCHES, STREAMS, & CREEKS LESS THAN 3 FEET WIDE

Provide two (2) Top of Bank (TS), Creek (CR), or Ditch (DL) along the top outside edge of feature. Provide a Drain line (ODL) feature along the deepest section of the feature.

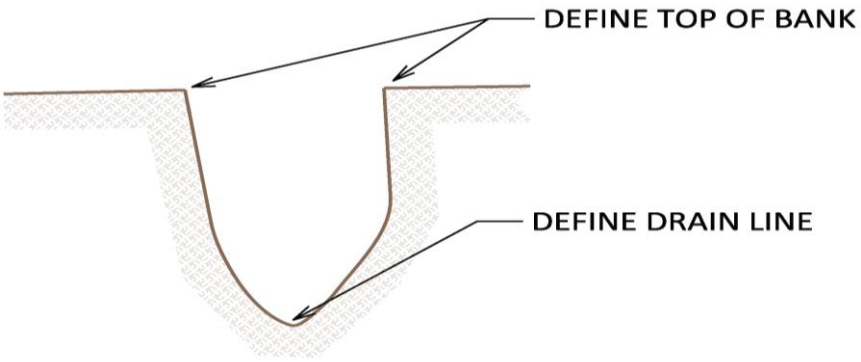


Figure 32 OUTFALL DRAINAGE SURVEY DETAIL – CROSS SECTION

Figure 34 OUTFALL DITCH SURVEY EXAMPLE

3.07.02 OUTFALL DITCHES, STREAMS, & CREEKS MORE THAN 3 FEET WIDE

Provide two (2) Top of Bank (TS), Creek (CR), or Ditch (DL) along the top outside edge of feature. Provide two (2) Drain Lines (ODL) along the toe or bottom of the feature.

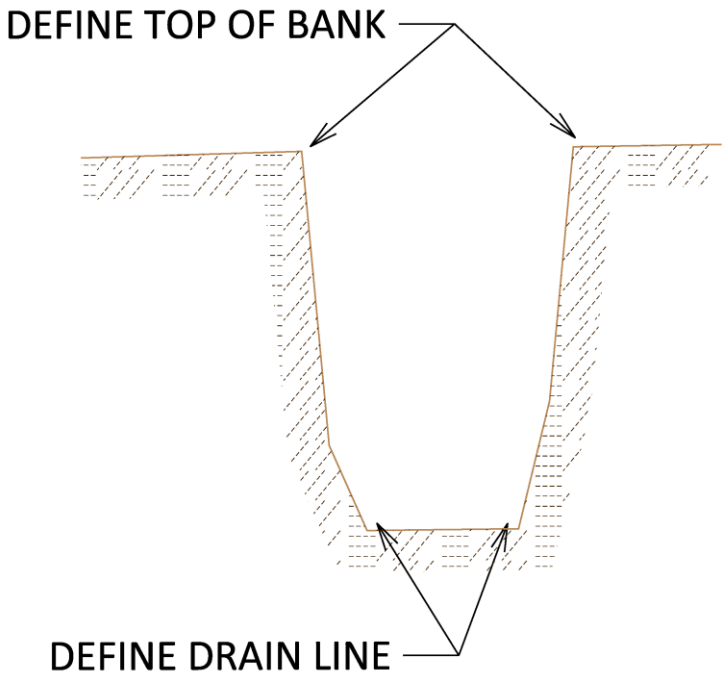


Figure 36 OUTFALL DRAINAGE SURVEY DETAIL – CROSS SECTION

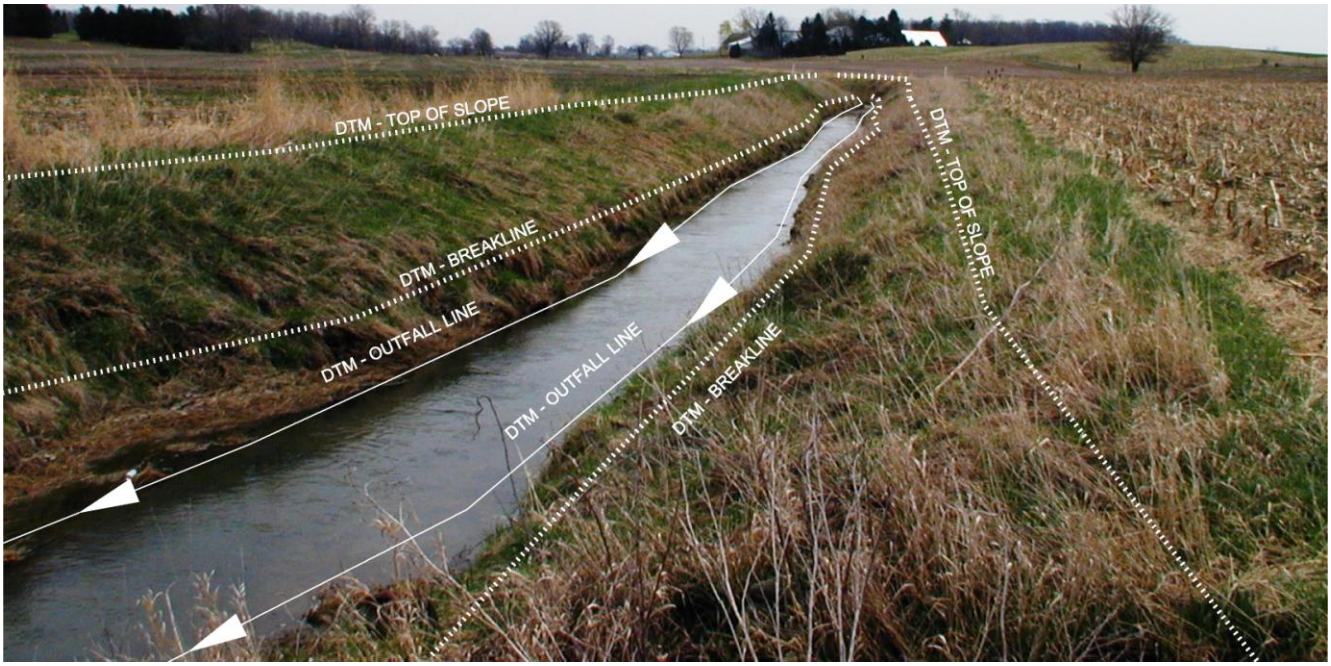


Figure 38 OUTFALL DITCH SURVEY EXAMPLE 2

3.08 HORIZONTAL / BEST FIT ALIGNMENTS

3.08.01 RE-ESTABLISHING EXISTING ALIGNMENTS

The SCDOT considers roadways and associated features, as constructed, as monuments to the existing right of ways and reference alignments. It is a requirement to research and compile all existing roadway construction and right of ways plans from the SCDOT and county or municipalities. The surveyor must be able to combine the intent of the original, or most current, plans with the existing roadway to establish a **Best Fit Existing Roadway Alignment**. In turn, the surveyor will take the original, or most current, plans depicting right of ways and create a **Best Fit Right of Way** using the Best Fit Roadway Alignment.

3.08.02 ESTABLISHING OUTFALL ALIGNMENTS

Reference alignments are calculated for outfall drainage features. These alignments are created and calculated as follows:

- Alignments generally run South to North
- Alignments consist of Non-Tangent lines with Non-Tangent Points of Intersection
- NTPI are calculated in the center of and at major bends in the ditches
- Extend the Tangent closest to the interesting roadway alignment
- Alignments will be named OFL01, OFL02, etc.

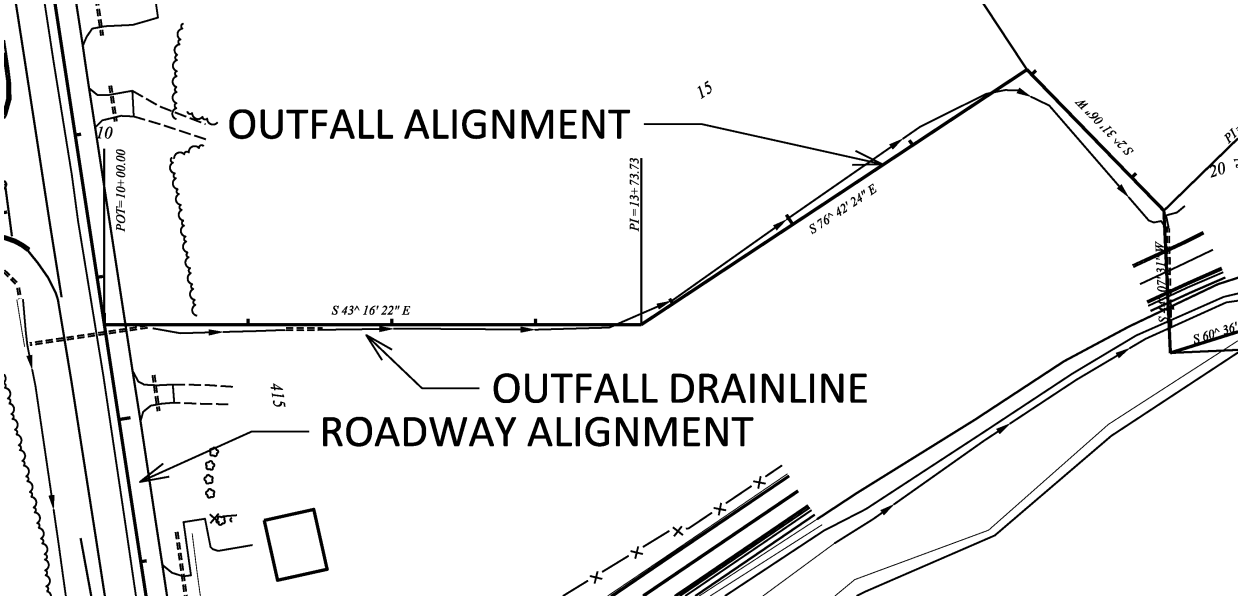


Figure 40 OUTFALL DRAINAGE ALIGNMENT

3.09 PROPERTY AND RIGHT OF WAYS SURVEYS

All surveying of existing Right of Ways shall adhere to the standards, practices, and policies set forth in the Standards of Practice Manual for Surveying in South Carolina. Base mapping of existing Right of Ways, Easements, Property, and/or other real property rights must be developed to a sufficient level of accuracy to support due process for Right of Way appraisal and acquisition. (Survey, 2008)

3.09.01 RE-ESTABLISHING EXISTING RIGHT OF WAYS

The SCDOT considers roadways and associated features, as constructed, as monuments to the existing Right of Ways and reference alignments. It is a requirement to research and compile all existing roadway construction and right of ways plans from the SCDOT and county or municipalities. The surveyor must be able to combine the intent of the original, or most current, plans with the existing roadway to establish a **Best Fit Existing Roadway Alignment**. In turn, the surveyor will take the original, or most current, plans depicting right of ways and create a **Best Fit Right of Way** using the Best Fit Roadway Alignment. All existing Right of Ways established for the project must be referenced to a SCDOT Project File No.

3.09.02 DEPICTING PRIVATE PROPERTY

A thorough search of the public record will be made to identify and review deeds and plats applicable to the boundaries of the properties that will be affected by the project. Instruments for easements and rights of way that are part of the public record will also be reviewed and identified. Where ground conditions indicate the existence of easements or rights of way, sufficient contacts and research will be made to identify the easement or right of way.

An extensive search will be made to locate all property monuments identified from research and will be within the limits of any new right of way or construction for the project. All property corners will be located from MSC points.

Boundary surveys of individual parcels are not normally performed for individual parcels. The side lines for properties immediately adjacent to SCDOT Right of Ways are generally developed by utilizing the position of the found monuments, the property boundary information in deeds and plats, ground evidence of ownership lines, information from property owners, and sources of information for right of way and easement lines.

Property owner information will be tabulated in an excel spreadsheet (123456prop.xlsx) showing the following information:

- Owner Name(s)
- Property and Mailing addresses
- Deed Book and Page, Plat Book and Page Reference
- Tax Map Reference
- Total Acreage per records

Copies of all documents collected will be compiled, organized, and bound into one of two project notebooks and submitted to the DEPARTMENT:

- Deeds / Documents
- Plats / Maps

3.10 BRIDGE / CULVERT SURVEYS

Bridge Surveys will be performed to provide both accurate bridge planimetry and appurtenance locations as well as DTM information for hydrographic and bridge design.

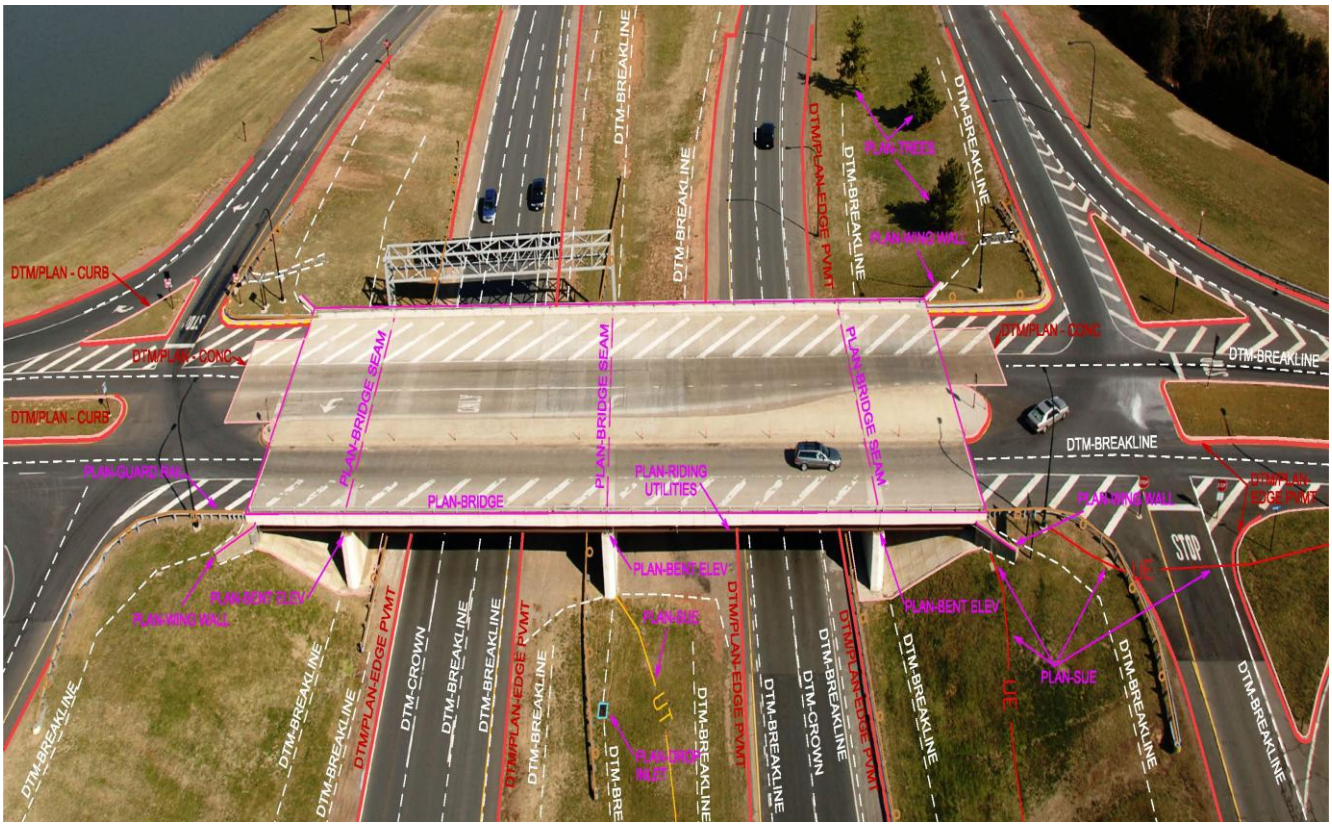
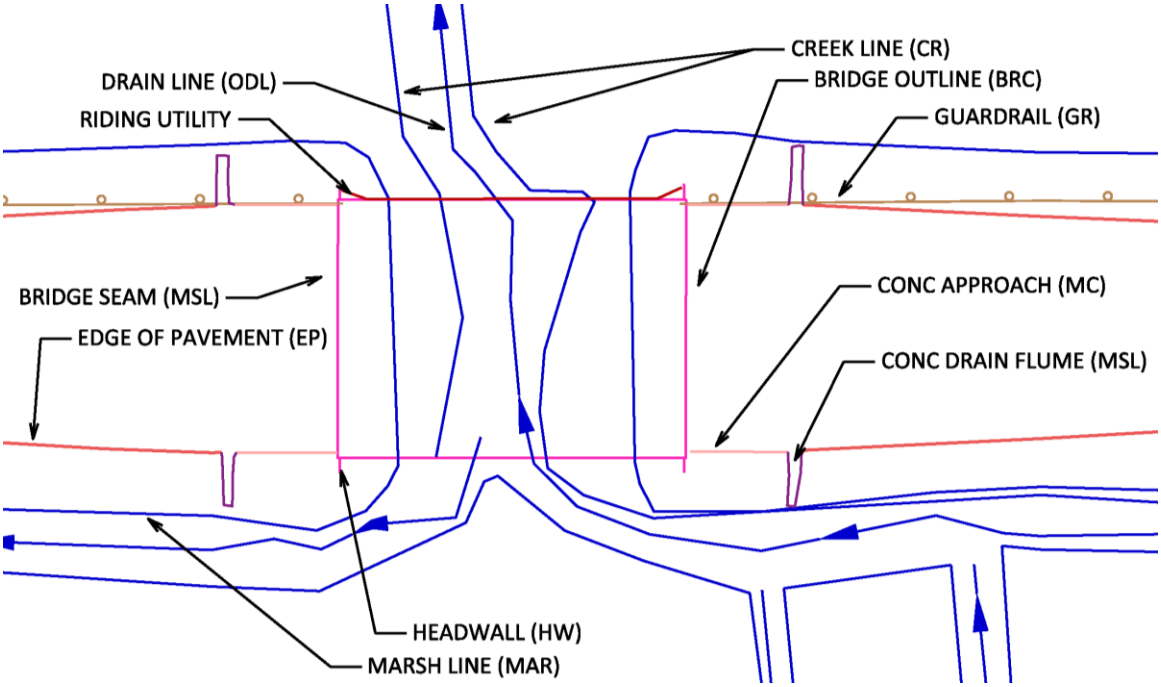


Figure 42 HIGHWAY BRIDGE SURVEY EXAMPLE

3.10.01 BRIDGE PLANIMETRY

Bridge structures will be shown in the survey planimetry file. When locating features that are used in both the plannimetric and DTM files (such as Edge of Pavement, Crown, etc), do not extend them across the bridge decks. Bridges should be located by four corners for a tangent structure. For curved structures, outline the structure sufficiently show the location in a plan view. Other pertinent plannimetric data to be surveyed or mapped are as follows:

- Bridge Seams
- Abutments (Endwalls, wingwalls, etc)
- Centerline Bridge Seats with Elevations
- Riding utilities
- Low Beam Elevation
- High water elevation.
- Normal edge of water.
- Flood Way & 100 year Flood (Floodplain) location.



BRIDGE LOCATION - PLAN VIEW

Figure 44 BRIDGE SURVEY DETAIL – PLAN VIEW

3.10.02 ELEVATIONS ON BRIDGE STRUCTURE

Seat elevations of End Bents and Caps will be collected using a Spot Elevation (X) feature code along with any descriptions necessary.

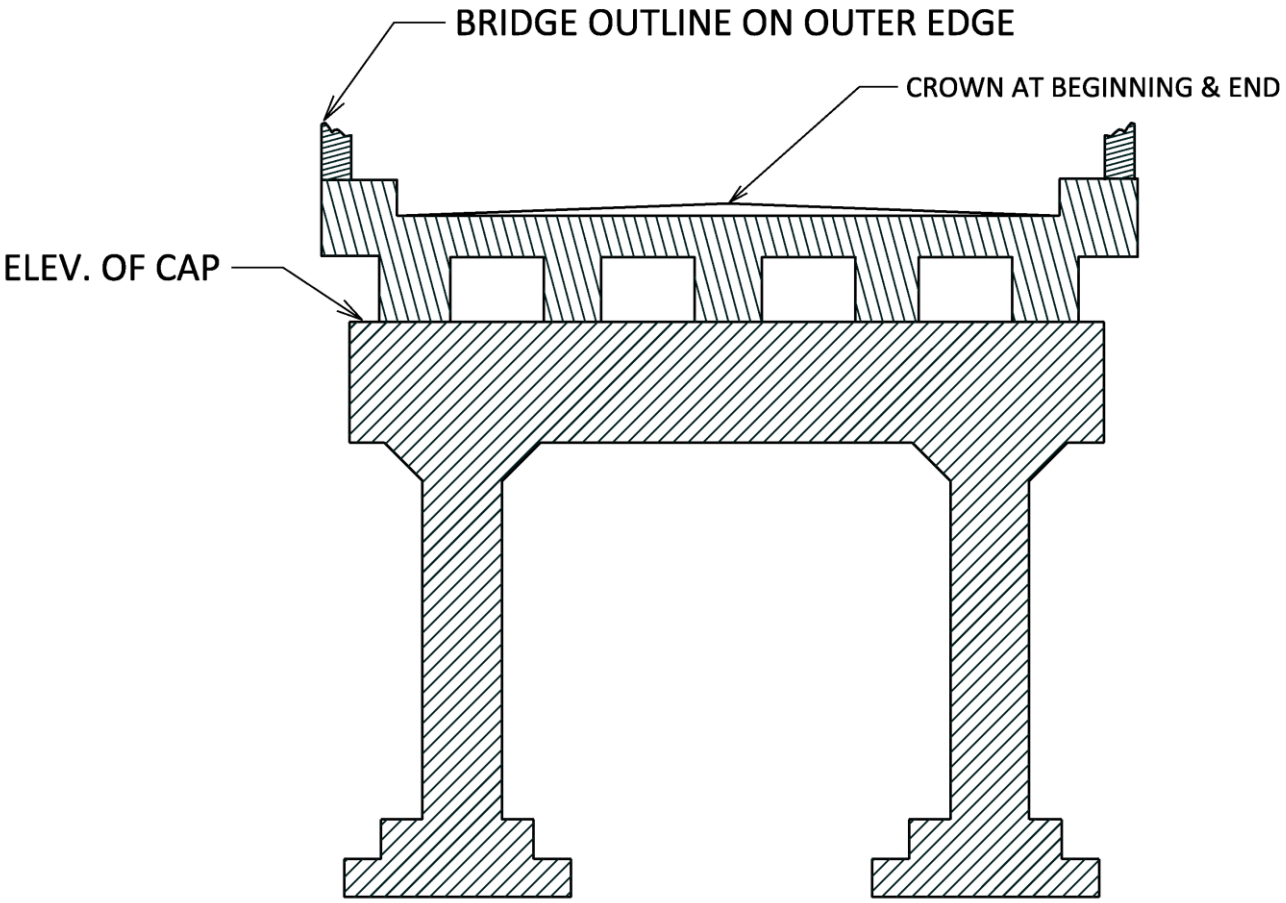


Figure 46 BRIDGE SURVEY DETAIL – CROSS SECTION VIEW

3.10.03 WATER ELEVATION LOCATION

Normal Water Elevation (NWE) and High Water Elevation (HWE) are singular point location shots. When locating the NEW location, note the date and time of survey. When locating the HWE, note the method of determination.

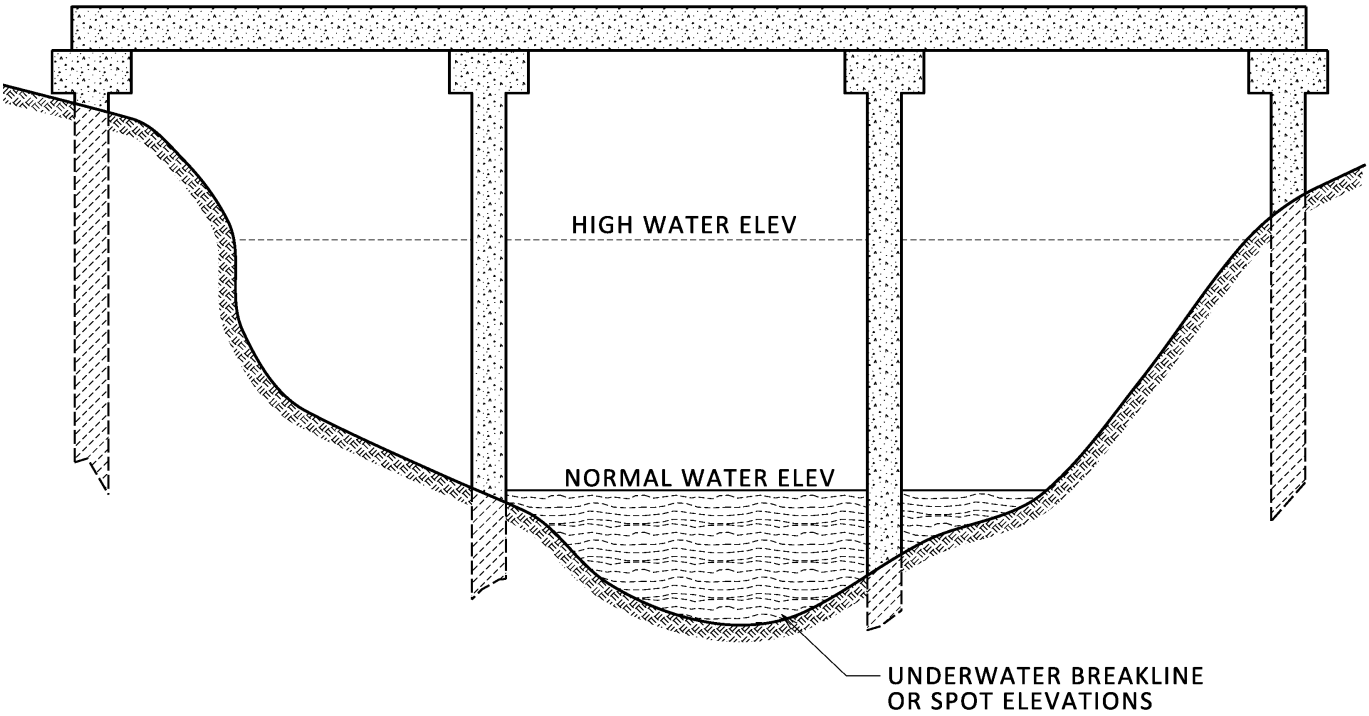


Figure 48 BRIDGE SURVEY DETAIL – WATER ELEVATIONS

3.10.04 BRIDGE DTM AND HYDROGRAPHIC SURVEY

In surveying for DTM information, topographic features need to be located as if the bridge decks do not exist. Breaklines need to be collected along the following features:

- Top back of headwalls, endwalls, wingwalls, etc,
- Bottom front of headwalls, endwalls, concrete embankments, etc.
- Top and bottom of roadway ditches feeding into stream / river

3.10.05 BRIDGE – STREAM CROSS SECTIONS

Surveyed stream cross-sections will extend a minimum of 500 ft. upstream and downstream of the proposed bridge location, with cross-section intervals no greater than on 100 ft stations. Include cross-section data at the proposed bridge face locations (both upstream face and downstream face) (Survey, 2008). Cross section data will points will include the following:

- Top of stream / river banks
- Toe or bottom of stream / river banks
- Thalweg (lowest point) of stream / river.

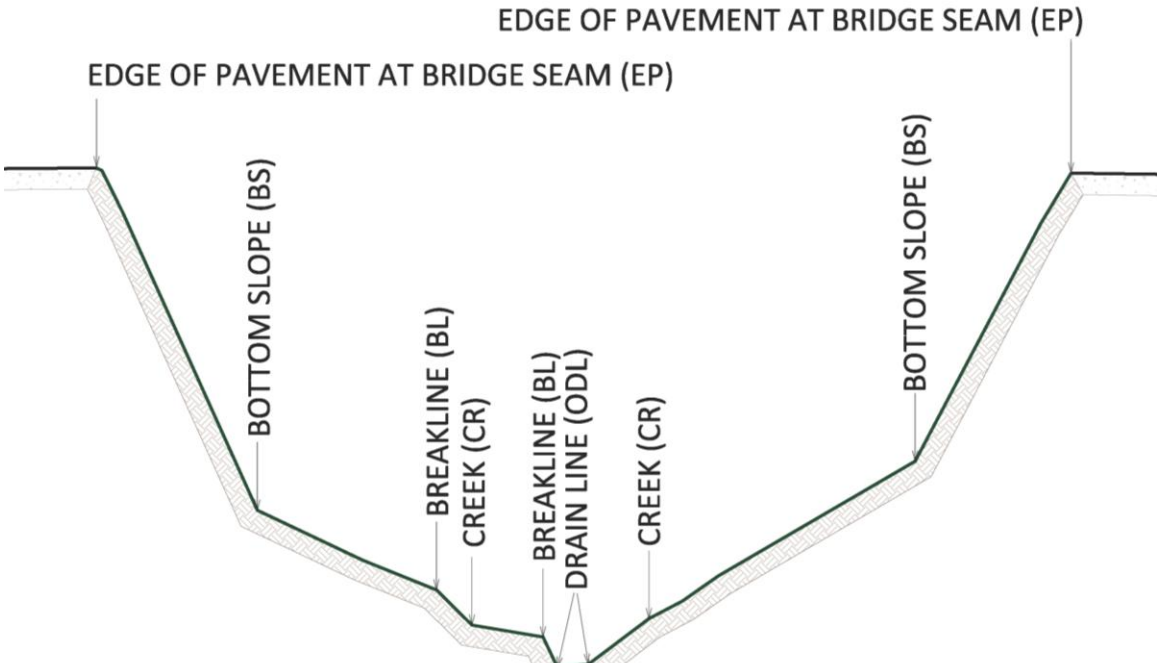


Figure 50 BRIDGE DTM SURVEY – CROSS SECTION VIEW

3.10.06 BLUE LINE STREAM

A **BLUE LINE STREAM** is defined as having a consistent flow throughout the year and is marked on a topographic quad map. Locate these streams with the Blue Line Stream (**BLS**) feature code.

3.10.07 DEEP WATER SURVEYS

SCDOT provides no directive or guideline for deep water channel cross sections. All surveying procedures and methods are required to meet or exceed the provisions found in the **MANUAL FOR THE PRACTICE OF LAND SURVEYING IN SOUTH CAROLINA**. The Department may request proof of professional competency and/or a special certification for large Hydrographic or Bathymetric surveys.

3.10.08 CULVERT SURVEYS

Survey culverts by locating the inside face of the inlet and outlet sections. If the culvert has Wingwalls or Headwalls, survey them by locating the top front of beginning and end. If the culvert has a concrete apron, survey it by locating the out edges. DTM shots are needed at the culvert locations, apron locations, and behind the wing walls. The following information will need to be included:

- Culvert Locations need to include the culvert inside dimensions
- Multi-Barrel culverts are located by Barrel.
- Wingwall & Headwall locations need to include wall width.

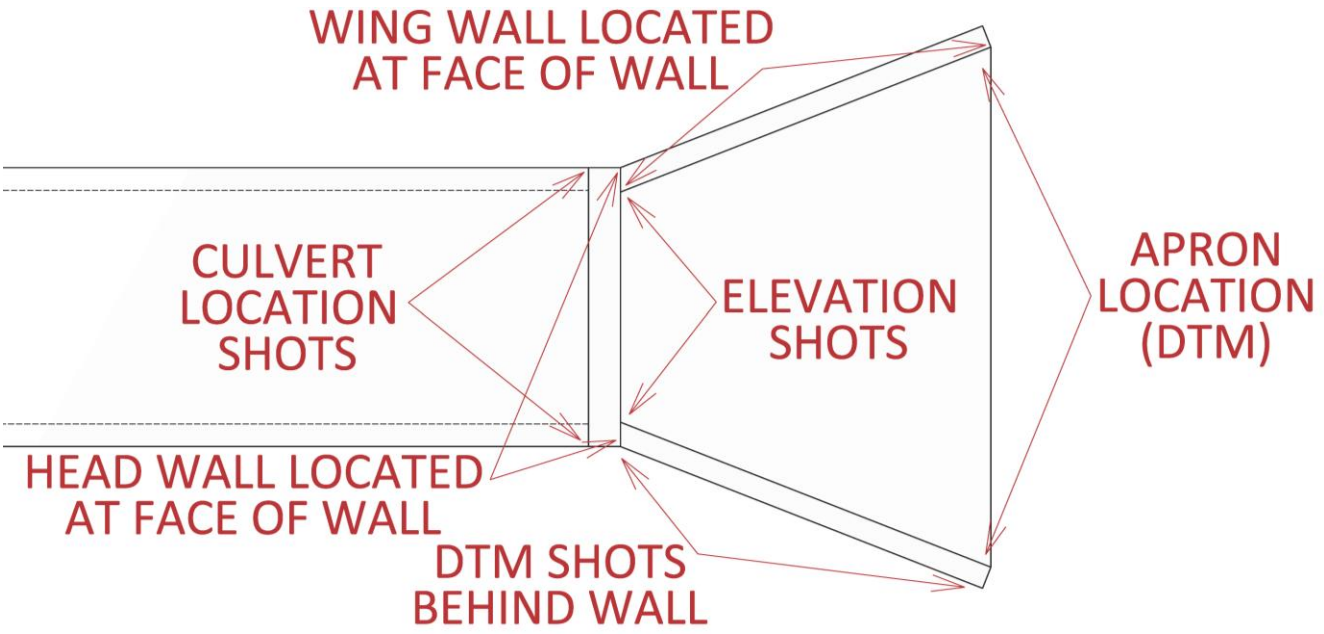


Figure 51 CULVERT SURVEY DETAIL – PLAN VIEW

3.10.09 CULVERTS IN PERENNIAL STREAMS

For culverts crossing perennial streams, cross-section data of the stream must be collected for a minimum of 100 ft from the culvert inlet and outlet. Cross-section data will be collected at a maximum of 25 ft stations. (Survey, 2008).

Figure 53 CULVERT SURVEY EXAMPLE

3.10.10 DRAINAGE PIPES

Locate storm sewer pipes with the following information:

- Pipe size
- Pipe Material
- Invert Elevation
- End Treatments (Flared end, Beveled, etc.)
- Special field conditions (crushed end, fully silted, etc)

3.10.11 MINOR HEADWALLS AND WINGWALLS

Locate Minor Structure wing and head walls in the same fashion as major structures. Walls are not included in the DTM file, so be sure to collect sufficient elevation data around the structures.

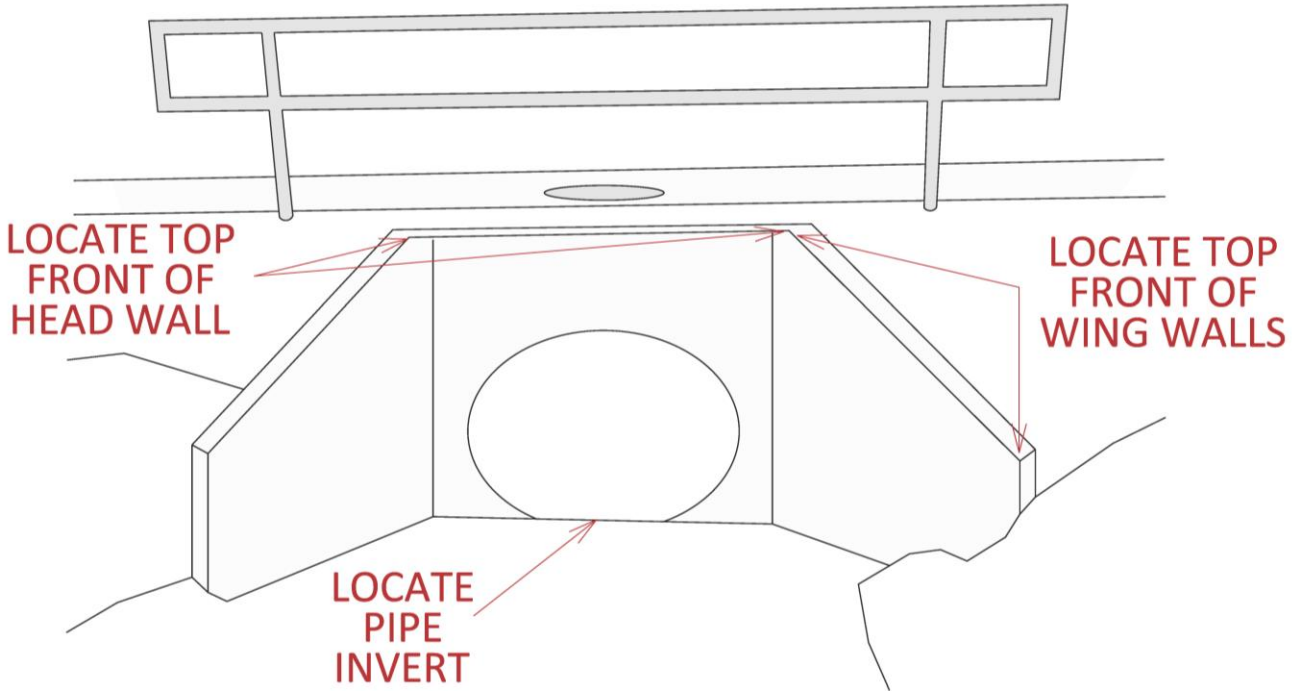


Figure 55 MINOR DRAINAGE WINGWALL

3.10.12 INLET STRUCTURES

Curb Inlets are generally located with a minimal amount of shots depicting the following information:

- Center Top of Structure with structure code and description of type or size
- Curb Flow Line Elevation Shot

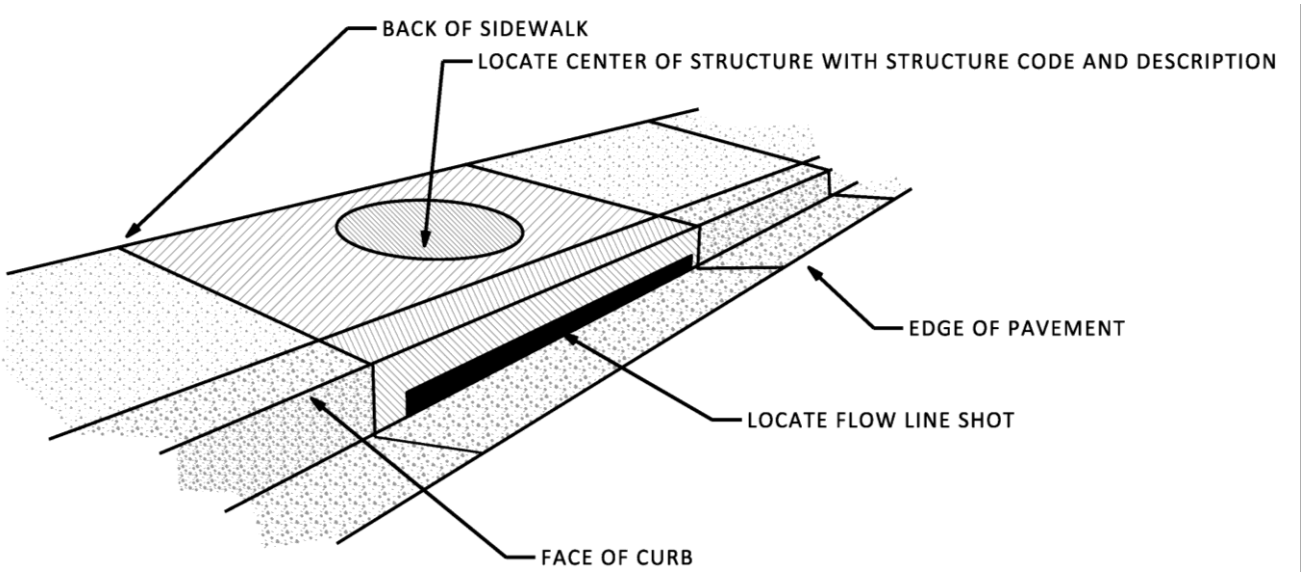


Figure 57 CATCH BASIN LOCATIONS

Drop inlets are located similarly to catch inlets:

- Center Top of Structure with structure code and description of type or size
- Center Top Elevation Shot
- Grates larger than 3'x3' should be located by corners as well
- Locate concrete aprons with Concrete codes

3.11 RAILROAD SURVEYS

All projects that require land acquisition or encroachment permits from a Railroad Company will require the following survey information for plan development:

- Location of all railroad appurtenances
- Existing drainage structures and flow patterns
- Railroad right of way
- All mile markers within the project or reference to the nearest railroad mile marker (milepost shot must tie to something)

If a project involves a parallel encroachment on the railroad right of way, include the following information in the survey:

- Distance to tracks (all measurements are referenced from the centerline of the tracks)
- Cross sections from the project to mainline tracks with ground line & top of rail elevations
- Topography to the mainline tracks
- All drainage structures and channels between the road project and mainline tracks with elevations of flow line and top of structures
- Nearest railroad right of way line to road project

If a project involves a grade separating crossing, include the centerline of the railroad a minimum of 200 feet left and right of the roadway survey centerline with appropriate topography and cross section at 25 foot intervals.

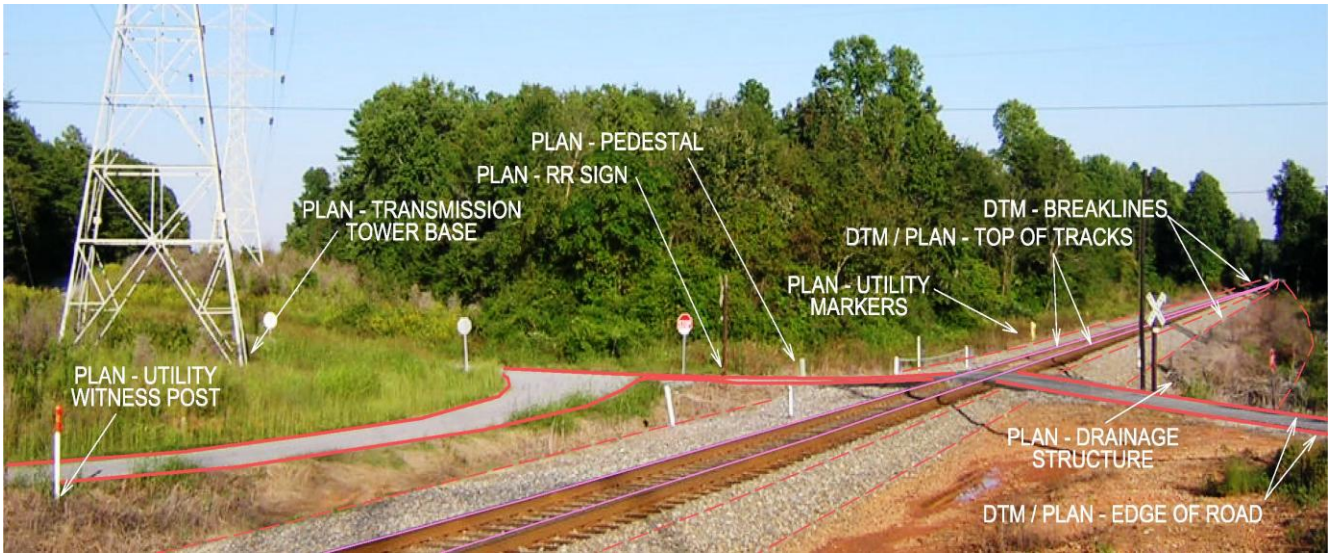


Figure 59 RAILROAD SURVEY EXAMPLE

3.12 PLANIMETRIC SURVEYS

All cultural (man-made) and natural features pertinent to the roadway project will be located and mapped. These items include, but are not limited to the following:

- Roadways, curb and gutter, paved areas
- Sidewalks, trails
- Buildings, canopies, decks, steps
- Signs, mailboxes, columns, flag poles
- Stately trees, ornamental trees, wooded area boundaries, shrubs
- Fences, walls, guard rails,
- Streams, rivers, lakes, marshes
- Utility poles, telephone pedestals, meter boxes

All planimetric features should include descriptions of its material, type, species, size, condition, etc. On projects where aerial survey was used, it will be necessary classify the planimetric features shown in the mapping (building type, tree species and sizes).

3.13 TOPOGRAPHIC (DTM) SURVEYS

Within the pre-determined survey corridor, three dimensional data will be collected for all topographic breaklines, natural and cultural (man-made) features, and ground survey data. All measurements along longitudinal features or breaklines will be taken at regular intervals, not to exceed 50 ft spacing between shots.

3.14 SUBSURFACE UTILITY ENGINEERING SURVEYS

The standard survey practice of accurately finding the location and elevation of all aboveground utility topography will be required for most projects. For other projects, where the location of underground utilities is considered critical to the design process, Subsurface Utility Engineering (SUE) services shall be used.

SUE is a method for identifying the location of subsurface utilities at various levels of quality. Each quality level is defined by the thoroughness, accuracy and methods used in gathering the subsurface utility information.

SUE Survey Feature codes are included in this manual. Please refer to the current revision of the SCDOT SUE CADD Manual for CAD leveling and drafting resources.

3.15 ENVIROMENTAL SURVEYS

Environmental areas, such as protected species habitats, will be located as directed by the environmental engineers. Make note of delineation or area collection methodology.

3.15.01 FLOODPLAIN SURVEYS

SCDOT references **Chapter 5.4.4.3 of the FHWA Project Development and Design Manual** for the required standards for surveying and mapping flood plains. Some major aspects of these standards are as follows;

- Cross-section data must include full width of the flood valley
- Cross-sections should indicate the general slope & topography of the plain
- Aerial surveys are often the best way to provide a comprehensive depiction of the floodplain

The figure below depicts the methodology used by FEMA for their Flood Hazard Mapping Program.

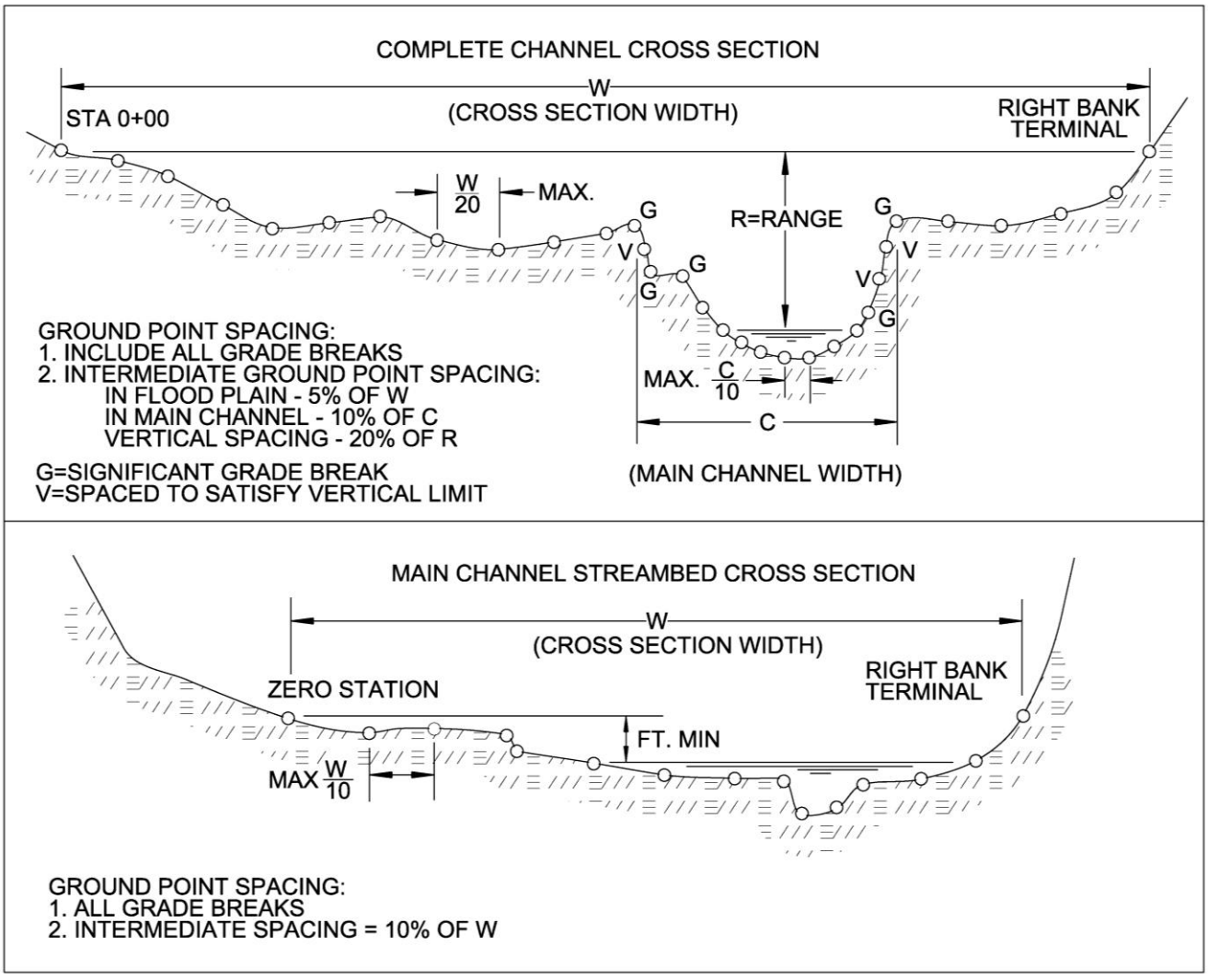


Figure 61 FLOOD PLAIN LOCATION METHODS

3.15.02 WETLAND AREAS

Wetland surveys are generally the surveyed location of an environmental engineer's flagged delineation of wetland areas. Locate flags noting the flag color and design and the flag number. Make note of wetlands located by other methods (soils, vegetation, etc)

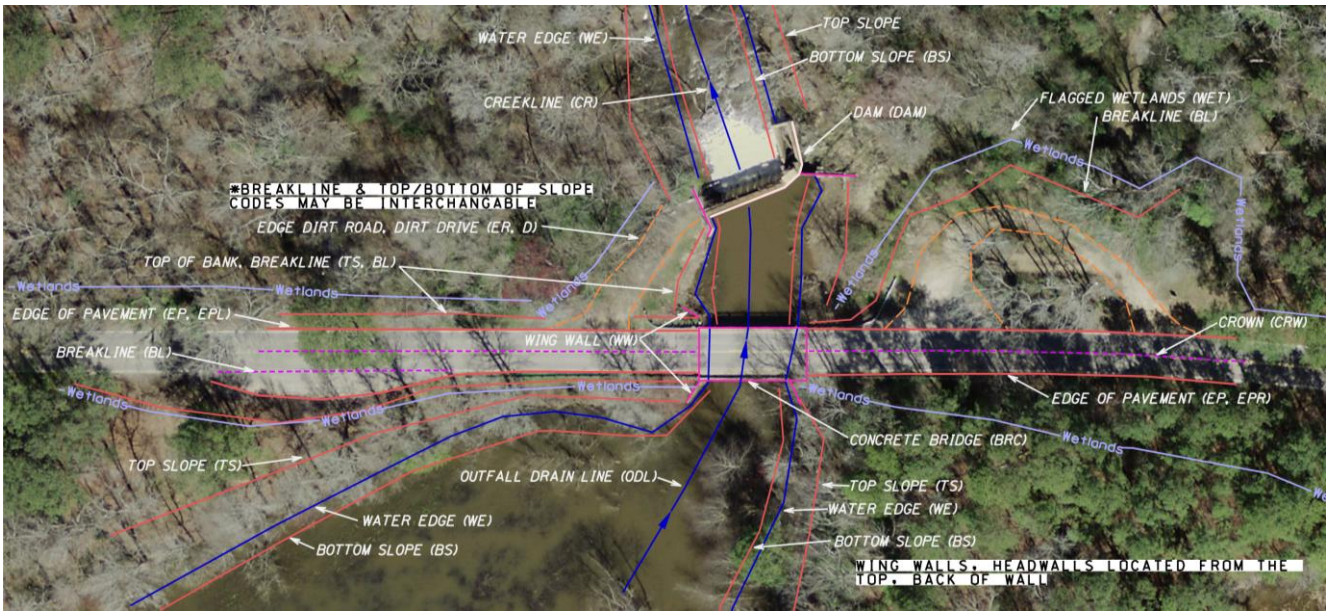


Figure 62 Wetland area example on bridge survey

3.16 PRECONSTRUCTION SURVEY STAKING & MONUMENTS

Many surveying Scope of Services will include Right of Way Staking. Effective January 01, 2011, all new contracts that call for acquiring new right of way will include re-establishing Right of Way Monuments and the setting of new Right of Way Monuments on the existing and new right of ways.

3.16.01 RIGHT OF WAY STAKING

TEMPORARY RIGHT OF WAY STAKING –The **CONSULTANT** will **STAKE** the designed project Right of Way for the purpose of Right of Way acquisition and utility relocations as directed by the **DEPARTMENT.** The total area **STAKED** will not exceed the linear equivalence of twice the entire project Right of Way length. All Right of Way break points including POTs, PCs, PTs, and Transition Right of Way points will be **STAKED**. The Right of Way along extended Tangents will be **STAKED** on 100' stations and Curves will be **STAKED** at 50 foot stations. Right of Way **STAKES** will be fabricated as follows:

- 36" x 2" x ¾" wooden stake
- 6" White band painted on the top or white flagging
- Alignment side of stake will show Right of Way width – **XX RW**
- Transition Right of Way width will be shown as – **TRANS RW**
- Property side present Station **XX+XX.XX**

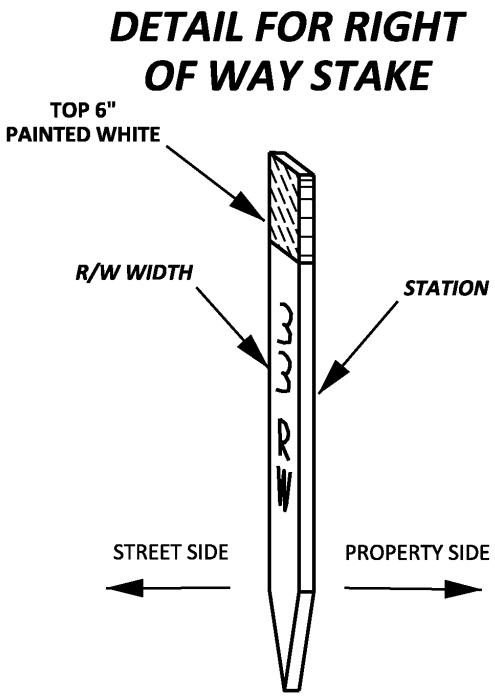


Figure 64 RIGHT OF WAY STAKE DETAIL

3.16.02 RIGHT OF WAY PLATS

Information for Right of Ways being performed in conjunction, and as a bid item, on a construction project is provided in a Preconstruction Advisory Memorandum (number eight). This plat will document the locations of all right of way markers that have been set and reflecting the "as built" station and offset from the plan centerline. Each plat will be in accordance with the requirements of Section 49-460-A "A General Boundary Survey" as outlined in the "Standards of Practice Manual for Surveying in South Carolina." A copy of the plat will be recorded, by the contractor, in the Register Mesne Conveyance (RMC) office of the county or counties in which the project resides. The contractor will provide one copy of the plat on a full sized plan sheet(s) (22" X 36") and submit to the resident construction engineer to be included in the as-built plans.

The following is from SCDOT Standard No. 809-105-00 which is to be used for all R/W Markers;

1.1 The Contractor shall prepare a Right of Way Plat signed and sealed by the South Carolina Professional Land Surveyor in Charge. The plat will document the locations of all Right of Way markers that have been set and reflecting the as-built station and offset from the plan centerline. Each plat shall be in accordance with the requirements of the section 49-460-A "General Boundary Survey" as outlined in the "Standards of Practice Manual for Surveying in South Carolina".

1.2 A recordable copy of the Right of Way plat shall be prepared and recorded in the RMC office f the county or counties in which the project resides. The plat shall also be provided on a full sized plan sheet (22" x 36") and submitted to the resident engineer to be included in the As-Built Plans.

2.1 Right of Way (R/W) Markers will be placed to identify the station of the project. R/W Markers shall be placed plumb and accurately at every ground accessible point along the R/W at the Points of Curvature and Point of Tangency of curves and at even station intervals. In rural areas, R/W markers should not be more than 700 feet apart on curves and no more than 1400 apart on tangents. In urban areas, R/W markers should not be more than 500 feet apart for both curves and tangents.

2.2 Use type of R/W marker (concrete post or recap & cap) as indicated in the plans or special provisions.

2.3 R/W markers shall be installed in accordance with the following criteria:

- *a. At break points in the R/W lines(s)*
- *b. Points of R/W opposite proposed curvature points of control (i.e. PC, PT)*
- *c. Points along R/W which maintain forward and backward line of sight.*
- *d. Maximum distance between any two markers along a continuous R/W line in 1400 ft.*
- *e. Ideally, R/W markers shall not be placed at points which are common to property lines and/or corners*

The PLS shall set right of way markers along all new right of way lines as well as along any present right of way being retained by the Department at intervals listed on the SCDOT Standard Drawings. Right of way markers shall not be placed at points common to side property lines and/or corners. In the event that the plan reflects a break in the right of way along a side property line the right of way marker will not be set without the side property line being retraced and established by way of survey. The PLS shall prepare a plat documenting the location of all Right of Way Markers set and reflecting the as-built station and offset from the plan alignment. The plat shall show the entire project corridor as an enclosed strip or parcel of land to include the mainline and all side roads as defined on the project plan.

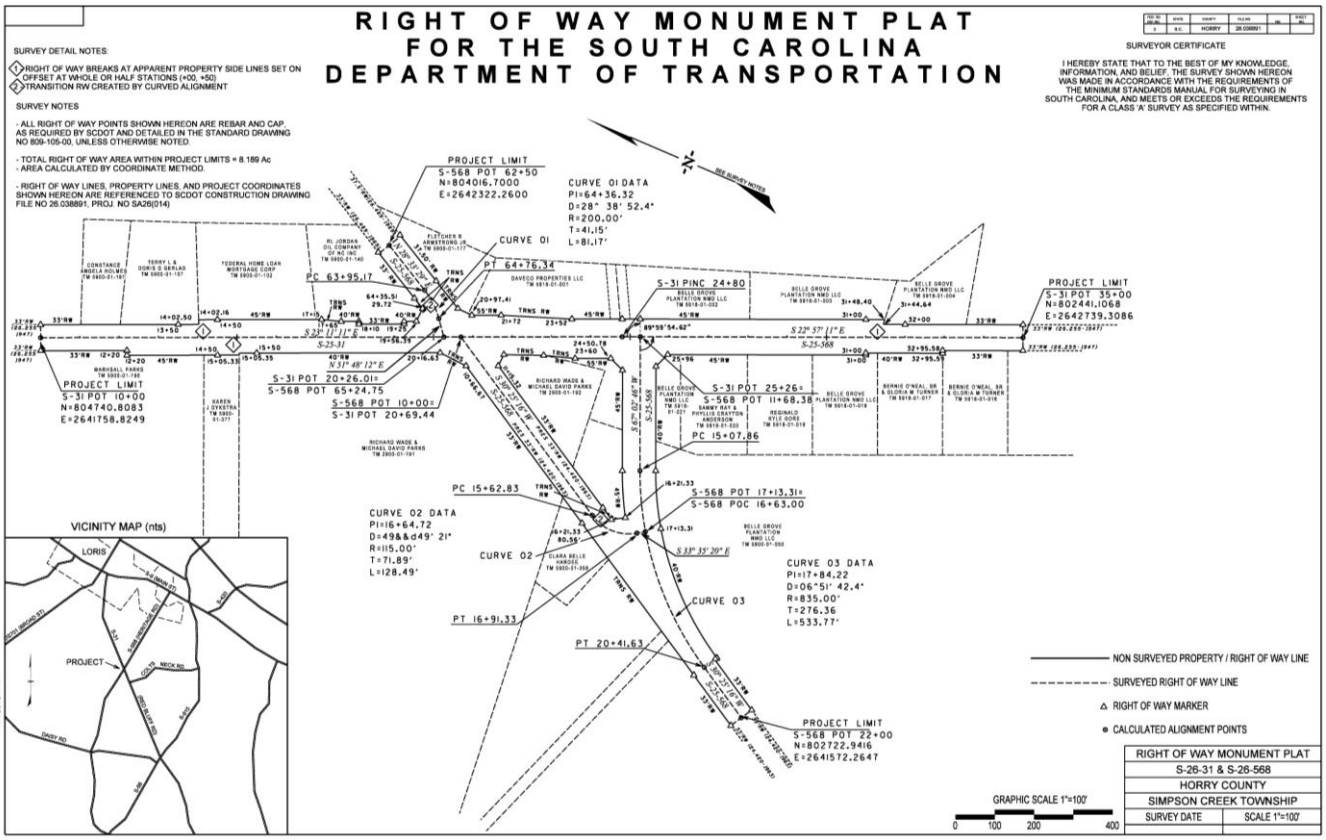


Figure 66 RIGHT OF WAY PLAT

3.16.03 RIGHT OF WAY MARKERS

Right of Way Markers (RWM) will be placed to identify the stationing of a project. RWM shall be placed plumb and accurately at every ground accessible point along the Right of Way (R/W) line at the point of curvature and point of tangency of curves and at even station intervals. In rural areas, RWM should not be more the 700 feet apart in curves and no more than 1400 feet apart in tangents. In urban areas, RWM should not be more than 500 apart for both curves and tangents. RWM should not be set at points which are common to property lines and/or corners.

3.17 QA-QC & GROUND TESTS

Throughout the project design levels, topographic verification and design location surveys may be necessary to guarantee design to field conformity and that critical areas and tie-in points reflect the sufficient level of accuracy (Survey, 2008). Some items that may be subject to testing include, but are not limited, to the following:

- Relocation Alignment tie-in points
- New Alignment tie-in points
- Designed outfall structure points
- Proposed easements or utility location
- Construction limits, slope stakes
- Critical environmental areas

4.0 DATA COLLECTION FEATURE CODES & PROCEDURES

This section is provided as a courtesy and is not indented as a requirement for surveying procedures. Use of the SCDOT Survey Feature Codes will assist in creating CADD mapping and COGO databases that are fully compatible with SCDOT CADD Standards.

4.01 GENERAL OVERVIEW

Features will be classified as either **POINT**, a feature whose position can be defined by a single measurement or total station shot, or **LINE (CHAIN),** which is a feature shown by a string or series of connected points. The codes used in the description for electronic data submitted to headquarters office must be identical to the codes described herein in order for the CADD system to recognize the applicable features. Except for use of numbers for multiple line features, nothing else can be in or immediately next to the feature code unless it is separated from the code by a dash at the end of the code. Example: **POT-123+86** where a space separates the Pot feature code from the station number.

Any additional description needed to describe the point can be placed after the feature code provided a delimiter separates it. This will include such information as size and type of a pipe, size and type of a tree, height and type of a fence etc. Examples: **IP-1CP** = 1" dia Crimped Iron Pipe, **BM-20LP** = Bench Mark in 20" Loblolly Pine.

4.02 FEATURE CODES

SMD Codes denoted with an asterisk (*) may be amended with L or R to depict left or right of alignment if required. Example EP can be EPL for left side or EPR for right side or just EP.

4.02.01 GEOMETRIC ALIGNMENT CONTROL

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style	Weight	Cell	DTM/ PLN	Line Point
RD_HC_CL (Roadway Centerline)		*100*	*149*	*(0)*	*6*		2D	Line
RD_HC_Data (Geometric Data)		*101*		*(0)*	*2*		2D	Text
Curve Data							2D	Text
Bearing							2D	Text
Reference Points							2D	Point
Equalities							2D	Text
Bearings							2D	Text
Beginning and Ending Notes							2D	Text
RD_HC_Data_Tic (Station marks)		*102*	*149*	*(0)*	*3*		2D	
RD_HC_txCode (Geometric code)		*107*	*0*	*(0)*	*0*			

ICL: Intersecting Road Centerline to define the alignment of an intersecting road without the establishment of horizontal curve points. Also used for 300 ft profile along intersecting roads.

PIO: Point of Intersection on Outfall Alignment defines the vertexes for the Outfall Drainage Alignments (**ODL**).

4.02.02 SURVEY CONTROL

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style	Weight	Cell	DTM/ PLN	Line Point
RD_HC_Survey		*114*	*149*	*(0)*	*2*			
Primary Survey Control	PSC					PSC	2D	Point
Main Survey Control	MSC					MSC	2D	Point
Project Benchmark	PBM					PBM	2D	Point
Geodetic / NGS Control	GEO					GEO	2D	Point
Generic Control Point	CP					CP	2D	Point
Generic Benchmark	BM					BM	2D	Point
RD_HC_Survey_txCode (Survey code)		*214*	*0*	*(0)*	*0*			

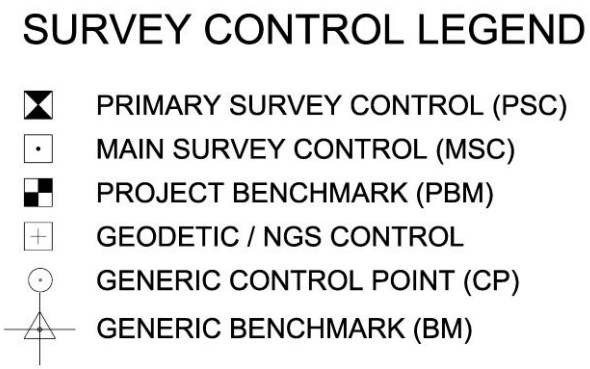


Figure 68 SURVEY CONTROL GRAPHIC LEGEND

4.02.03 BUILDINGS, BUILDING APPURTENANCES, & CHURCHES

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_Bldg		*115*	*6*	*(0)*	*6*			
Building (outline)	B						2D	Line
RD_EX_Bldg_txCode (Survey Codes)		*116*	*0*	*(0)*	*0*			
RD_EX_BldgApp (Appurtenances)		117	6	*(0)*	2			
Air Conditioning Unit	AC					AC	2D	Point
Flood / Ground Light	FLT					FLT	2D	Point
Mail Box	MBX					MAIL	2D	Point
Res. Power Outlet	OUT					EOUT	2D	Point
Satellite Dish	SAT					SAT	2D	Point
Sprinkler	SPK					SPK	2D	Point
Underground Tank (Gas, Septic)	UGT					UGT	2D	Point
Sign Post	SP					SIGN	2D	Point
Sign	SN						2D	Line
Flag Pole	FP					FLAG	2D	Point
Columns	C					COL	2D	Point
Square Wall Columns	WC					WC	2D	Point
Water Monitoring Well	WMW					WMW	2D	Point
Water Spigot	SPG					SPG	2D	Point
Well	WELL					WELL	2D	Point
Commercial Vacuum	VAC					VAC	2D	Point
Fill cap for Underground Tank	CAP					CAP	2D	Point
Canopy / Overhang on Building	CNP						2D	Line
Gas Pump Island	GPI						2D	Line
Wall	W						2D	Line
Clothes Line	CL						2D	Line
Above Ground Tank	AGT						2D	Line
Steps	STP						2D	Line
Porch Deck	BPD						2D	Line
Gas Pumps	GPP					GPP	2D	Point
Planter	PLT						2D	Line
Walkways (non concrete)	WLK						2D/3D	Line
RD_EX_BldgApp_txCode (Survey Codes)		*118*	*0*	*(0)*	*0*			
RD_EX_BldgChurch		*119*	*6*	*(0)*	*6*			
Church, Synagogue and Mosques (outline)	CRC						2D	Line
Cemetery (outline)	CEM						2D	Line
Grave	GRV					GRV	2D	Point
RD_EX_BldgChurch_txCode (Survey)		*120*	*0*	*(0)*	*0*			
RD_EX_BldgSchool		*121*	*6*	*(0)*	*6*			
School, College	SCH						2D	Line
RD_EX_BldgSchool_txCode (Survey)		*122*	*0*	*(0)*	*0*			

STP: Steps. Need shot on each side of bottom step with number of risers in additional description.

GRV: Single grave location. Give shot at the point that appears to be closest to the survey centerline and should be used in conjunction with **CEM** (Cemetery) to show graves that may be affected by the project.

CEM: Defines cemetery boundary.

SN: Sign. Apply to a wide sign such as a billboard to define each end.

SP: Sign Post.

WEL: Well. Give shot at point on ground closest to the survey centerline. Provide additional information as needed. For example "WEL PUMP" would designate a well with a pump and "WEL OPEN" would designate an open well. If the well has a pump house, a point is needed for the well and then the pump house needs to be shot as a building.

C: Column. One shot at the center of the face closest to the road. Additional description should give dimensions and type of material. Example: **C-24X24BR** = 24” square brick column.

W: Wall. First shot coded **W** for beginning of wall line should give material and height. For example, **W-48BR** will mean the first shot on a line of brick wall 48 inches tall. As long as the wall remains the same material and approximate height, remaining description only needs to be **W** until you get to the end, which will then be **W** to end the line.

4.02.03.01 BUILDING DESCRIPTOR CHART

Construction Material	Building Code	Building Usage	Usage Code
Framed (all siding materials)	F	Dwelling, Residence	D
Stucco	S	Business	B
Brick	B	Church	C
Block	K	Storage	S
Metal	M	Shed	H
Log	L	Garage	G
		House Trailer	T
Building Condition	**Condition Code**		
Abandoned	A		
Dilapidated	R		

Follow the building code shot with description in following order: 1) Number of stories 2) Building Condition (when applicable) 3) Construction Material and 4) Building Usage.

Example of Building code: **B-1AFD** = 1 Story Abandoned Framed Dwelling
B-2KB = 2 Story Block Business

4.02.04 BRIDGES AND DAMS

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_Bridge (all)		*123*	*27*	*(0)*	*2*			
Concrete Bridge	BRC						2D	Line
Wood Bridge	BRW						2D	Line
Head Wall	HW						2D	Line
Wing Wall	WW						2D	Line
Existing Culverts	CVL						2D	Line
Existing Bridge Piers	EBP						2D	Point
Existing Bridge Caps	EBC						2D	Point
RD_EX_Bridge_txCode (Survey)		*124*	*0*	*(0)*	*0*			
RD_EX_Dam		*127*	*223*	*(0)*	*4*			
Dam	DAM						2D	Line
RD_EX_Dam_txCode		*128*	*0*	*(0)*	*0*			

BRC / BRW: Bridge-Concrete / Wood. Shot needed on each corner of the bridge.

CVL: Culvert. Shot needed on each of four corners. (Sketches in field notes)

DAM: Dam. Used to define the toe of the embankment for a dam where water is impounded away from the survey centerline. If the centerline is on the dam, the shot should be given at the top edge of the embankment on the side of the centerline where water is impounded.

4.02.05 EROSION CONTROL AND STORM SEWER

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_DR_Inlet (Storm sewer)		*133*	*106*	*(0)*	*2*			
Catch Basin	CB					CB	2D	Point
Drop Inlet	DI					DI	2D	Point
Junction Box	JB					JB	2D	Point
Drainage Man Hole	DMH					DMH	2D	Point
RD_EX_DR_Inlet_txCode (Survey)		*134*	*0*	*(0)*	*0*			
RD_EX_DR_Pipe (Storm Pipes)		*135*	*106*	*(0)*	*2*			
Pipes	P			PIPE EXIST			2D	Line
RD_EX_DR_Pipe_txCode (Survey)		*136*	*0*	*(0)*	*0*			

CD, MD, PD: Followed by size in inches and Pipe Code from list below. I.E. – **12AC =** 12" Asbestos Cement. Elliptical pipes are shown as Height, Width, & Material. I.E. – **14X23RC** = 14"x23" Concrete.

JB: Junction Box. Since this cannot be located on the ground surface, this would normally be a calculated location and a "?" should be placed in the additional description when applicable.

4.02.05.01 PIPE TYPE CODES

Pipe Type	Pipe Code	Pipe Type	Pipe Code
Concrete (Reinforced & other)	RC	Corrugated Metal	CM
High Density Polyethylene	HD	Corrugated Plastic	CP
Polyvinyl Chloride	PV	Orangeburg Pipe	OP
Vitrified Clay	VC	Steel	ST
Asbestos Cement	AC	Terra Cotta	TC
Ductile Iron	DI	Steel Wrapped Coated	SW
Cast Iron	CI	Truss Pipe	TP

4.02.06 HYDROLOGICAL AND WETLANDS

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_H2O (Pond, Lake, Creek, etc)		*149*	*1*	*(0)*	*2*			
Edge of Water (Ponds, Streams, etc)	WE						2D/3D	Line
Berm Ditch	BD*						2D/3D	Line
Creek	CR*						2D/3D	Line
Ditch	DT*						2D/3D	Line
Marsh	MAR						2D/3D	Line
Swamp	SWP						2D/3D	Line
Spring Area	SPR						2D/3D	Line
Existing Outfall Ditch	ODL						2D/3D	Line
Ditch Banks	DT*						2D/3D	Line
High Water Mark	WH						2D	Point
Normal High Water	NHW			NHW			2D	Line
Retention Pond (Top Bank, Pond)	RDP			RDP			2D/3D	Line
RD_EX_H20_txElev (High Water Elev)								
RD_EX_H2O_txCode (Survey)		*150*	*0*	*(0)*	*0*			
RD_EX_H2O_BlueLn (Blueline stream)		*151*	*190*	*(0)*	*2*			
Blue Line Stream							2D	Line
RD_EX_H2O_BlueLn_txCode (Survey)		*152*	*0*	*(0)*	*0*			
RD_EX_H2O_WetLd (Wetland, Jursd area)		*153*	*189*	*(0)*	*2*			
Wetland Boundary	WET						2D	Line
RD_EX_H2O_WetLd_txCode (Survey)		*154*	*0*	*(0)*	*0*			

**Add L or R to SMD Code to depict left or right of alignment if required.*

SPR: Will usually be used to outline a spring area.

CR: Shot at the top of the bank on both sides of creek or stream.

DT: May be used with the **ODL** to locate one of the edges of an existing ditch along the survey **ODL**.

BD: Generally applies to the top edge of a berm ditch.

SWP, MAR, WE: Used to define the edge of a swamp, marsh, or body of water.

WH: Single shot at a high water mark.

4.02.07 RIGHT OF WAY AND BOUNDARIES

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style	Weight	Cell	DTM/ PLN	Line Point
RD_EX_DV_Gov (Munc Limits)		*137*	*87*	*(0)*	*2*			
City / Town Limits, County & State Lines							2D	Line
RD_EX_DV_TX_Gov (Area ID)		*141*	*87*	*(0)*	*2*			
City/County/State Text Identification							2D	Text
RD_EX_DV_Prop (Lines)		*138*	*0*	*(0)*				
Property Lines				PROP LINE			2D	Line
Easement Lines				RW LINE			2D	Line
RD_EX_DV_TX_Prop(Owner ID)		*142*	*0*	*(0)*	*2*			
Property Owner Text/Tract # Id							2D	Text
RD_EX_DV_Prop_txCode (Survey Code)		*139*	*0*	*(0)*	*0*			
RD_EX_DV_PropPin (Prop Corners)		*140*	*0*	*(0)*	*2*			
Concrete Monument	CM					CM	2D	Point
Property Corner	IP					IP	2D	Point
RD_EX_DV_PropPin_txCode (Survey)				*(0)*				

The ability to determine the location of property corners and lines during the field survey is dependent upon varying ground evidence conditions, availability of recorded property plats, and availability of deeds and property descriptions that can readily be identified on the ground from available evidence. Due to the flexibility that must be afforded, the survey crew chief is to apply his judgment for the conditions that apply to each land parcel. Codes alone cannot be expected to fully describe property boundaries.

The following codes apply to coordinate points stored in the electronic data file. This data must still be accompanied by field drawings by the survey crew of property, copies of plats, tax maps, or other available documents that can relate property boundaries to the highway project. These drawings, plats, etc. should have the point numbers labeled on them at the points' corresponding location.

All property corner and right of way shots should include measurement for a description. All measurements should be from the outer most edge of item. Diameter measurements should always be measured to the outside edge of pipe.

All property and right of way points will be located to their center-most point of the top of the item. Disturbed or Bent items should include a description of location method as well as condition and measurement.

LOP, LOE: Occupational or Easement Line (2 Shots on Line). This will be useful for fence lines or other ground features that are used as the property or easement line.

4.02.07.01 RIGHT OF WAY AND PROPERTY MARKER DESCRIPTION CHART

Marker Type	Code	Marker Type	Code
Right of Way Concrete Monument	RW	Misc Property Corner	MC
Right of Way Stamped Cap	RWC	Nail	NL
Right of Way Line	RWL	Nail & Cap	NC
Angle Iron	AI	Occupation Line	OP
Axle	XL	Open Pipe	OP
Bolt	BT	Crimped Pipe	CP
Cedar Marker	CR	PK Nail	PK
Concrete Monument	CM	Railroad Spike	RR
Disturbed or Bent Property Corner	DB	Rebar	RB
Etched "X"	EX	Rod	RD
Flat Iron	FI	Spike	SK
Mag Nail	MN	Square Bolt	SB

4.02.08 ROADS, PAVEMENT, AND CONCRETE

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_Driveway (Non-conc)		*129*	*81*	*(0)*	*2*			
Dirt Drives	D	129	81		2		2D/3D	Line
Asphalt Drives	DP	129	81		2		2D/3D	Line
RD_EX_Driveway_txCode (Survey)		*130*	*0*	*(0)*	*0*			
RD_EX_Conc		*125*	*221*	*(0)*	*2*			
Face of Curb	CF*						2D/3D	Line
Misc Curb, Top of Curb	MC*						2D/3D	Line
Concrete Median	MDC						2D/3D	Line
Roadway Crown	CRW						2D/3D	Line
Sidewalk, Back of Sidewalk	SW*						2D/3D	Line
Concrete Driveway	DC						2D/3D	Line
Concrete Pad / Slab	CPD						2D/3D	Line
RD_EX_Conc_txCode (Survey)		*126*	*0*	*(0)*	*0*			
RD_EX_Road (Edge of pvmt, soil road,etc)		*159*	*14*	*(0)*	*3*			
Edge of Pavement	EP*						2D/3D	Line
Edge of Dirt Road	ER*			3			2D/3D	Line
Valley Gutter	VG*						2D/3D	Line
RD_EX_Road_txCode (Survey)		*160*	*0*	*(0)*	*0*			

CF: Face of Curb of Curb and Gutter. Give shot at the gutter point of the face. Additional description with the first point CF should identify whether it is 18 inch or 24 inch wide type. This only needs to be given with the point to start the line. Example **CF-18** = Begin 18" Face of Curb

VG: Valley Gutter. Used for a paved ditch. Give shot at flow line point and provide additional description with VG to identify width and paving material. If width changes appreciably at other points, give different widths in additional description.

4.02.09 FENCES & GUARDRAIL

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_Fnce_ChLk		*143*	*6*	*(0)*	*2*			
Chain Link Fence	CLFR CLFL			FENCE - CLF			2D	Line
RD_EX_Fnce_ChLk_txCode (Survey)		*144*	*0*	*0*	*0*			
RD_EX_Fnce_Other (Non-chain, woven)		*145*	*245*	*(0)*	*2*			
Privacy Fence (Board), Picket, Vinyl	FR,FL			FENCE LINE			2D	Line
RD_EX_Fnce_Other_txCode (Survey)		*146*	*0*	*(0)*	*0*			
RD_EX_GuardRail (Guardrail & Post)		*147*	*22*	*(0)*	*2*			
Guardrail including Connectors	GR			EX GR RT EX GR LT			2D	Line
Posts or Anchors with Type Description	GA					GA	2D	Point
RD_EX_GuardRail_txCode (Survey)		*148*	*0*	*(0)*	*0*			

The Fence points designate the beginning of a fence line. Should include size and material using the Fence Type Code as shown below: I.E. – **F-84CB** = 84" Commercial Chainlink with Barbed Wire.

GR: Give shots along the edge of the guardrail closest to the survey centerline.

4.02.09.01 FENCE TYPE CODES

Fence Type	Fence Code	Fence Type	Fence Code
Chainlink	C	PVC	PV
Vinyl	V	Commercial Chainlink	CC
Wrought Iron	W	Commercial Chainlink with Barbed Wire	CB
Wood Board	WB	Picket	PT
Split Rail	SR	Privacy	PY
Barbed Wire	BW	Electric Wire	EW
Chicken Wire	CW	Welded Wire	WW
Woven Wire	WV	Mesh Wire	MW
Hog Wire	HW	Smooth Wire	SW
Post & Rail	PR	High Tensile Wire	TW
Aluminum	AL	Wood Lattice	WL

4.02.10 RAILROADS

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_RailRoad		*157*	*7*	*(0)*	*2*			
RR Track	RR			RAIL ROAD LINE			2D/3D	Line
Signal Box	RRB					RRB	2D	Point
Mile Post	RRM					RRM	2D	Point
Signal	RRS					RRS	2D	Point
Trestle	RRT					RRT	2D	Line
Crossing Arm	RRX					RRX	2D	Point
RD_EX_RailRoad_txCode (Survey)		*158*	*0*	*(0)*	*0*			

RR: Railroad Track. If track crosses the centerline, need to give shots on each rail for a distance of 300 feet or other specified distance left and right of the survey centerline. Each rail must be completed from beginning to end before another rail can be recorded. If the tracks are left or right of, and in the general direction of the survey centerline, shots are needed on the rail closest to the survey centerline only.

RRS: Shot on post at edge point closest to survey centerline.

RRX: Shot on post at edge point closest to survey centerline.

RRM: Give mile number in additional description.

RRT: Give four shots to define the four corners of the trestle beginning with **RRTA** and ending with **RRTB.**

4.02.11 UTILITY FEATURES (NON – SUE)

Level Name (Type)	SMD	Lvl	Color	Style	Weight	Cell	DTM/	Line
Feature	Code	No.					PLN	Point
RD_EX_UT (Non -SUE)		*164*	*3*	*(0)*	*2*			
Overhead Electric Lines	OP			ELEC LINE ABOVE			2D	Line
Power Poles	PP					PP	2D	Point
Meter Poles	MP					MP	2D	Point
Light Poles	LP					LP	2D	Point
Power Line Tower	PLT					PLT	2D	Point
Electric Transformer Box	ETB					ETB	2D	Point
Electrical Pedestal	EPP					EPP	2D	Point
Traffic Signal Pole	TSP					TSP	2D	Point
Traffic Signal Box	TSJ					TSJ	2D	Point
Overhead Phone Lines	OT			PHONE LINE ABOVE			2D	Line
U/G Fiber Optic Lines	FOL			FIBER OPTIC			2D	Line
U/G Phone Lines	UT			PHONE LINE BELOW			2D	Line
U/G TV Lines	UTV			TV LINE UNDERGROUND			2D	Line
Telephone Pole	TP					TP	2D	Point
Telephone Booth	TB					TB	2D	Point
Cell Phone Tower	TCW					TCW	2D	Point
Telephone Pedestal	TPED					TPED	2D	Point
Telephone Box	TBX					TBX	2D	Point
TV Pedestal	TV					TV	2D	Point
Guy Wires	GW					GW	2D	Point
Guy Pole	GP					GP	2D	Point
Misc Pole	OP					OP	2D	Point
U/G Water Lines	UW			WATER LINE			2D	Line
Fire Hydrant	FH					FH	2D	Point
Water Meter	WM					WM	2D	Point
Water Valve	WV					WV	2D	Point
U/G Gas Lines	UG			GAS LINE			2D	Line
Gas Valve	GV					GV	2D	Point
Gas Meter	GM					GM	2D	Point
Existing Sewer Lines	SS			SANITARY SEWER			2D	Line
Septic Tanks	UGT					UGT	2D	Point
Sanitary Sewer Manhole	SMH					SMH	2D	Point
Sanitary Sewer Cleanout Vent	SSC					SSC	2D	Point
Utility Witness Post	WTS					WTS	2D	Point
RD_EX_UT_txCode (Survey Code)		*165*	*0*	*(0)*	*0*			

UGC: Shows the approximate location of a line of underground utility cable and should provide additional description.

AGT: Define by giving 4 shots, one at the horizontal position of each corner of a plane through the center of the tank.

GPI: Need two shots, one at each end of the side facing the survey centerline. Provide width by additional description.

PP: Give pole number if available in additional description.

TP: Give pole number if available in additional description.

GW: Guy Wire. Shot at the point where wire is fastened to ground.

SS: Sanitary Sewer. Give size, if known in additional information. If shot is not at the flow-line, designate by placing **NFL** in additional information. Example: **SS-6RCNFL** = 6" dia. sanitary sewer line without the point elevation equal to the flow line.

WL: Give an additional description for size and material.

GL: Shot on ground at approximate location of underground gas line.

ST: Approximate outline of tank should be shot with four shots.

TW: Need point for each of four corners. Also, high voltage power lines.

SAT: Satellite Dish. One shot at point closest to survey centerline.

4.02.12 VEGETATION AND TREES

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_VEG (Vegetation)		*166*	*2*	*(0)*	*2*			
Tree (General use)	T					T1	2D	Point
Pampas Grass	PG			PAMPAS		TPG	2D	Point
Shrub	S					SB1	2D	Point
Shrub Line	SL			SHRUB LINE			2D	Line
Hedge Row	H			SHRUB LINE			2D	Line
Wooded Area	TL,TR			TREE_LINE_LT TREE_LINE_RT			2D	Line
Flower Bed	F						2D	Line
RD_EX_VEG_txCode (Survey Code)		*167*	*0*	*(0)*	*0*			

Additional distinguishing information is required for all trees. For example, a 48-inch diameter Live Oak tree would have the description **T-48LO**

4.02.12.01 SUGGESTED TREE SPECIES DESCRIPTION CODES.

Code	Tree	Code	Tree	Code	Tree	Code	Tree
AB	American Beech	CP	Cabbage Palmetto	SW	Sourwood	PM	Plum
AE	American Elm	CT	Southern Catalpa	TO	Turkey Oak	PR	Pear
AH	American Holly	CY	Bald Cypress	VP	Virginia Pine	HL	Honeylocust
AS	American Sycamore	EH	Eastern Hemlock	WA	White Ash	LL	Laurel Oak
BC	Black Cherry	ER	Eastern Redbud	WB	White Basswood	LO	Live Oak
BE	Boxelder	FD	Flowering Dogwood	BB	Bayberry	LP	Loblolly Pine
BJ	Black Jack Oak	HB	American Hornbeam	BW	Black Walnut	MB	Red Mulberry
BL	Black Locust	PC	Peach	BY	Sweet Bay	SB	Sugarberry
BN	Black Willow	PM	Persimmon	CN	Swamp Chestnut Oak	SC	Spruce Pine
BO	Black Oak	WE	Winged Elm	CO	Chestnut Oak	SF	Sassafras
BT	Black Tupelo	WO	Water Oak	OK	White Oak	SG	Sweetgum
AP	Apple	WP	Eastern Whine Pine	OO	Overcup Oak	AT	Apricot
WN	Walnut	WT	Water Tupelo	OW	Willow Oak	MH	Longleaf Pine
SH	Shagbark Hickory	YP	Yellow Poplar	PE	Pecan	MN	Mockernut Hickory
SL	Shortleaf Pine	BK	Blackberry	PH	Pignut Hickory	NR	Northern Red Oak
SM	Southern Magnolia	BU	Blueberry	PN	Common Persimmon	RC	Eastern Red Cedar
SO	Scarlet Oak	CR	Cherry	PO	Post Oak	RM	Red Maple
SP	Slash Pine	CU	Chestnut	PP	Pond Pine	RB	River Birch
SR	Southern Red Oak	CR	Cranberry				

Example 12” River Birch = **T-12RB**

4.02.13 MISCELLANEOUS

Level Name (Type) / Feature	SMD	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_EX_Misc (Miscellaneous Data)		*155*	*5*	*(0)*	*2*			
Misc Point	MSP					MSP	2D	Point
Misc Line	MSL						2D	Line
Misc Graphics (N Arrow, etc)						NA	2D	
RD_EX_Misc_txCode (Survey)		*156*	*0*	*(0)*	*0*			

NOTE: Do NOT use the Miscellaneous Codes for features that should be used in the DTM.

MSP: Miscellaneous Point can be used for any point for a feature not coded. MSP must be followed first by a space and then a sufficient description to identify the feature.

MSL: Miscellaneous Line can be used to define and locate a line feature not coded. The starting **MSL** must be followed by sufficient description to identify the feature.

4.02.14 TOPOGRAPHIC, BREAKLINES, AND SPOT ELEVATIONS

Level Name (Type) / Feature	SMD Code	Lvl No.	Color	Style (Bylv)	Weight	Cell	DTM/ PLN	Line Point
RD_DTM_Bkln1		*425*	*14*	*(0)*	*0*			
Breakline	BL						3D	Line
Bottom of Slope, Toe of Slope	BS						3D	Line
Drain Field	DF						3D	Line
Flow-Line of Ditch	ODL						3D	Line
Roadway Crown	CRW						3D	Line
Top of Slope, Shoulder Break	TS						3D	Line
RD_DTM_Elev_Node			*4*			*SPOT*	*3D*	*Point*
Spot Elevation	X					SPOT	3D	Point
Spot Elevation on Roadway Profile	CL					SPOT	3D	Point
RD _DTM_Bkln_txCode (Survey)			*0*	*(0)*				

BL: Use for any topographic feature of elevation break over ground, pavement, parking, etc.

DF: use for drain field of drainage swales.

ODL: Use for the flow-line of ditch, preferably beginning at the higher end of ditch and running downstream.

4.03 SUE FEATURE CODES

4.03.01 ELECTRIC UTILITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Electric			
Record U/G Lines & Labels		PLN	LINE
Designated U/G Lines & Labels	UES	PLN	LINE
Transformer Box	ETBS	PLN	POINT
Power Manhole	PMS	PLN	POINT
Power Hand Hole	PHHS	PLN	POINT

4.03.02 TELECOMMUNICATION UTILITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Telecommunications			
Record U/G Lines & Labels		PLN	LINEAR
Designated U/G Lines & Labels	UTS,UTVS	PLN	LINEAR
Cable TV Pedestal	TVS	PLN	POINT
Telephone Pedestal	TPPS	PLN	POINT
Telephone Manhole	TMHS	PLN	POINT
Fiber Optic Hand Hole	FHHS	PLN	POINT
Telephone Hand Hole	THHS	PLN	POINT
Cable TV Hand Hole	TVHHS	PLN	POINT

4.03.03 UTILITY POLES AND OVERHEAD UTILITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Utility Poles			
Power Pole	PPS	PLN	POINT
Meter Pole	MPS	PLN	POINT
Light Pole	LPS	PLN	POINT
Guy Wire	GWS	PLN	POINT
Guy Pole	GPS	PLN	POINT
Transmission Tower	PLTS	PLN	LINEAR
Traffic Signal Junction Box	TSJBS	PLN	POINT
Traffic Signal Pole	TSPS	PLN	POINT
Telephone Pole	TPS	PLN	POINT
Cell Phone Tower	CTS	PLN	LINEAR
Misc Pole	OPS	PLN	POINT
SUE Overhead Utilities			
Overhead Lines & Labels	OHS	PLN	LINEAR

4.03.04 WATER UTLITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Water			
Record U/G Lines & Labels		PLN	LINEAR
Designated U/G Lines & Labels	UWS	PLN	LINEAR
Water Meter	WMS	PLN	POINT
Water Valve	WVS	PLN	POINT
Water Monitoring Well	WMWS	PLN	POINT
Fire Hydrant	FHS	PLN	POINT
Water Manhole	WMHS	PLN	POINT
Water Air Release Valve	WARS	PLN	POINT
Well House	WELLS	PLN	POINT

4.03.05 GAS UTILITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Gas			
Record U/G Lines & Labels		PLN	LINEAR
Designated U/G Lines & Labels	UGS	PLN	LINEAR
Gas Meter	GMS	PLN	POINT
Gas Valve	GVS	PLN	POINT
Gas Vent	GVTS	PLN	POINT
Gas Pressure Regulator	GRS	PLN	POINT
Gas Manhole	GMHS	PLN	POINT

4.03.06 SANITARY SEWER UTILITIES

Feature	Feature Code	DTM PLN	Linear Point
SUE Sewer			
Record U/G Lines & Labels		PLN	LINEAR
Designated U/G Lines & Labels	USS,FSS	PLN	LINEAR
Clean Out	SCOS	PLN	POINT
Manhole	SMHS	PLN	POINT
Air Release Valve	SARS	PLN	POINT

4.03.07 UNGERGROUND / ABOVEGROUND TANKS

Feature	Feature Code	DTM PLN	Linear Point
SUE Water Tank			
A/G & U/G Tanks	TNKS	PLN	LINEAR

4.03.08 TEST HOLES

Feature	Feature Code	DTM PLN	Linear Point
SUE Test Holes			
Test Hole Symbols	THS	PLN	POINT
Test Hole Symbols		PLN	

4.03.09 MICSELLANEOUS

Feature	Feature Code	DTM PLN	Linear Point
SUE Misc		PLN	
Misc Lines, Labels, & Symbols	MSLS	PLN	LINEAR
Text & Abbreviations		PLN	
SUE Sweep Limit		PLN	
Sweep Limit Lines		PLN	LINEAR
Text & Abbreviations		PLN	

4.03.10 SUE LEVELS

Please see the SCDOT SUE CADD Manual for SUE leveling and drafting resources.

4.04 SCDOT CADD WORKSPACE

The SCDOT provides their CADD Workspace environment files on the SCDOT website at http://www.scdot.org/doing/cadd_DesignFiles.aspx . Use of this workspace will ensure an efficient use of the Codes and Levels as provided in this manual. This files that are provided are as follows:

File Type	File Size	Web Update
DGN Libraries	29 Kb	1-2010
Cell Libraries	348 Kb	1-2010
Color Table	1 Kb	1-2009
Line Styles	7 Kb	1-2010
Fonts	1 Mb	1-2009
Seed Files	25 Kb	1-2010
Border Sheet Reference Files	1.2 Mb	1-2010
Roadway Level Chart	149Kb	1-2010
VBA Apps	349Kb	1-2010

GEOPAK Road V8i Downloads

File Type	File Size	Web Update
AASHTO K Values (.kvl)	1 Kb	1-2009
D&C Manager Database (.ddb)	70 Kb	1-2010
Geopak Drainage (.dlb)	18 Kb	1-2010
Geopak Labelers (.lsf)	23 Kb	1-2010
Plan Sheet (.psl) and XS Sheet (.xssl) Layout	6 Kb	1-2010
Superelevation Preferences (.sep)	2 Kb	1-2009
Geopak Survey (.smd)	57 Kb	1-2010
3pc (.3pc)	252 Kb	1-2010

5.0 SURVEY FILES DELIVERABLES

Preconstruction Surveying Consultants will deliver to the DOT files that are compatible with the Departments CADD and Plan Development Process. All Roadway Project within the Department are assigned a Project Pin Number. All files submitted by the Consultant will be referenced to a Pin Number. The types of files and naming conventions are listed below and are examples of some of the files that might be requested by the Department. The examples shown assume a Pin Number of 123456.

123456.xlsx	Project Information Spreadsheet (Section 5.1)
123456deed	Bound notebook containing copies of all deeds & documents for project
123456plat	Bound notebook containing copies of all plats and maps for project
456.gpk	GEOPAK coordinate geometry database file.
123456pp.dgn	2D Microstation file containing all Planimetric Mapping.
123456dtm.dgn	3D Microstation file containing all breaklines, spot elevs, triangulation and contours.
123456prop.dgn	2D Microstation file containing all property boundaries.

*Sheets may be combined in the most efficient manner.

Note: Any additional surveys submitted for the same project will follow the same naming convention but will add an A, B, C, etc. Example: for the first additional survey the file name will be 123456a.new, the second additional survey will be 123456b.new etc.

APPENDIX A – PHOTOGRAMMETRIC CERTIFICATION

PHOTOGRAMMETRIC CERTIFICATION PROJECT REPORT

Date: _____ Project Number: _____

Client Name: _____
_____
_____
_____

I certify that this project was completed under my direct and responsible charge from an actual photogrammetric survey made under my supervision; that this photogrammetric survey was performed to meet Federal Geographic Data Committee Standards as applicable. I further certify:

That the _____ aerial photography was taken on _____ at a nominal scale of 1"= _____ using a Wild RC30 aerial camera.

That the data was compiled by standard photogrammetric means using a Wild BC2 analytical stereo plotter. The map was compiled on _____.

That this data was compiled to meet ___ feet horizontal accuracy at 95% confidence level and the vertical data was compiled to meet ____ feet accuracy at 95% confidence level.

That the data was compiled at 1"= ____ with a ____ contour interval. The area compiled as approximately _____ acres located in _____.

That all ground control was obtained by _____.
Distances shown are grid lengths. To obtain horizontal ground distances, divide by a combined scale and sea factor of 0.9997756.
Horizontal datum: _____ Vertical datum: _____

All horizontal coordinates were referenced to the following marks:
NCGS Station Northing Easting Elevation

All vertical coordinates were referenced to the following marks:
NCGS Station Northing Easting Elevation

That all items compiled, except ground control points were obtained using photogrammetric methods.

That the data was compiled by: _____

_____
Signature Date

APPENDIX B – PROJECT COORDINATE FILE

```
*       SURVEY FIRM NAME
*       PROJECT COORDINATE FILE NAME
*
*
* PROJECT INFORMATION-
*   ROAD/ROUTE:                 PIN NO:
*   COUNTY:                     FILE NO:
*   CITY/TOWN:                  PROJ. NO:
*   LOCAL NAME:                 ITEM NO:
*
*   SURVEY INFORMATION-         REGIONAL SUPERVISOR:
*   UNITS:                      CHIEF OF PARTY:
*   VERTICAL DATUM:         SURVEY NUMBER:
*   NORTH ORIENTATION:          SURVEY STARTED:
*   STATE PLANE COORD:          SURVEY ENDED
*   SCALE FACTOR: 0.123456789
*
* DESCRIPTION-
*
* COMMENTS:
*
*
* NOTE:
*
* _____INDEX OF POINTS_____
*
*       TRAVERSE CONTROL.....1-5
*       ALIGNMENT CONTROL
*           MAINLINE S-10-66 NORTH.....6-15
*           S-10-870.....16-17
*           S-10-899.....18-19
*           US 17A.....20-23
*           S-10-66 SOUTH.....24-25
*       DRAINAGE CONTROL
```

APPENDIX C – CULVERT SKETCH

BOX CULVERT SKETCH

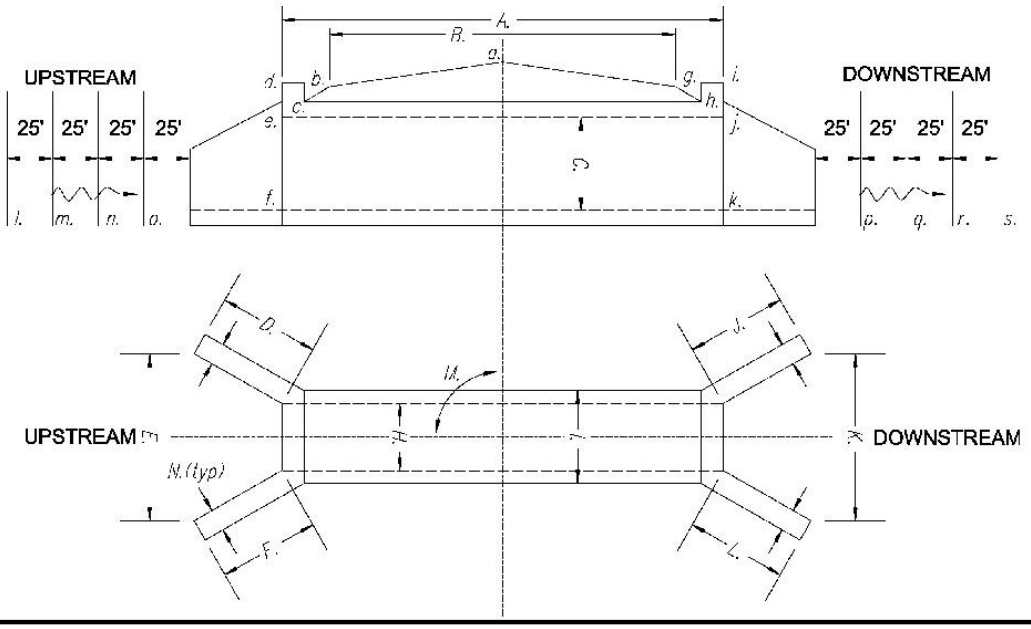
COUNTY: _____ ROUTE: _____

SIZE: _____ APPROACH PAVEMENT WIDTH: _____

BM: _____ ELEVATION: _____

WIDTH: _____ LOCATION: _____

FOUDNATION: _____ BOTTOM SLAB: _____



DIMENSIONS:

A. _____	F. _____	K. _____
B. _____	G. _____	L. _____
C. _____	H. _____	M. _____
D. _____	I. _____	N.(typ) _____
E. _____	J. _____	_____

ELEVATIONS:

a. _____	f. _____	k. _____	q. _____
b. _____	g. _____	l. _____	r. _____
c. _____	h. _____	m. _____	s. _____
d. _____	i. _____	n. _____	t. _____
e. _____	j. _____	o. _____	u. _____

*If no benchmark is available, assume an elevation of 50.00 at the centerline. If a benchmark is available, give the description, location and elevation. If the culvert is a different shape than shown, draw a sketch and use similar dimensions and elevations.

Note:

1. If culvert is skewed, state whether distance left and right of centerline is along skew or at rights angles to centerline of roadway. Also note whether headwalls are at right angles to the centerline or parallel to centerline of roadway.

2. If no bottom slab, give size and sketch of footing on reverse side.

SEE PAGE 2 FOR FIELD NOTES OR ADDITIONAL SKETCHES.

APPENDIX D – COMMON DRAINAGE STRUCTURES

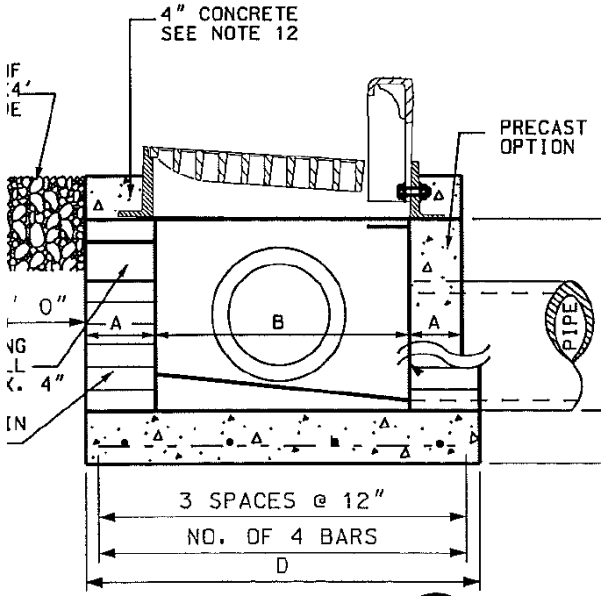


Figure 70 TYPE 1 CATCH BASIN

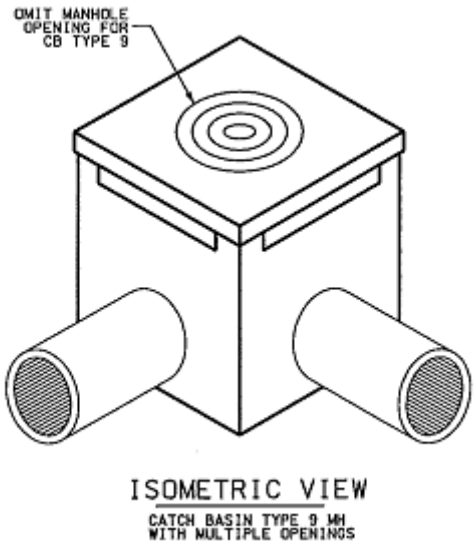


Figure 72 TYPE 9 CATCH BASIN

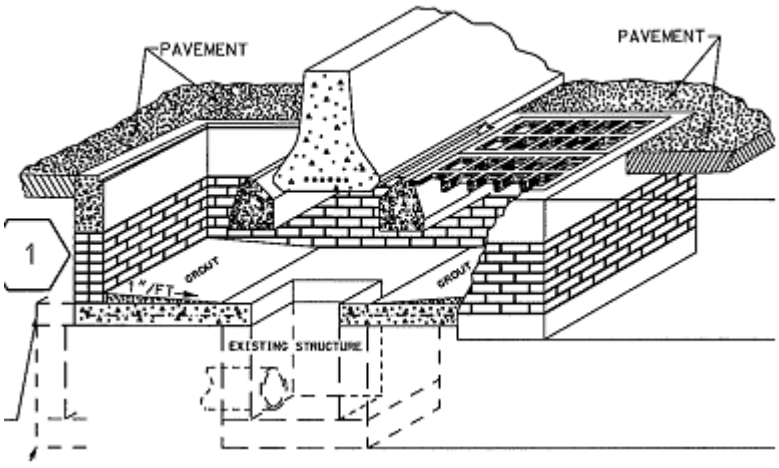


Figure 74 TYPE 15 CATCH BASIN

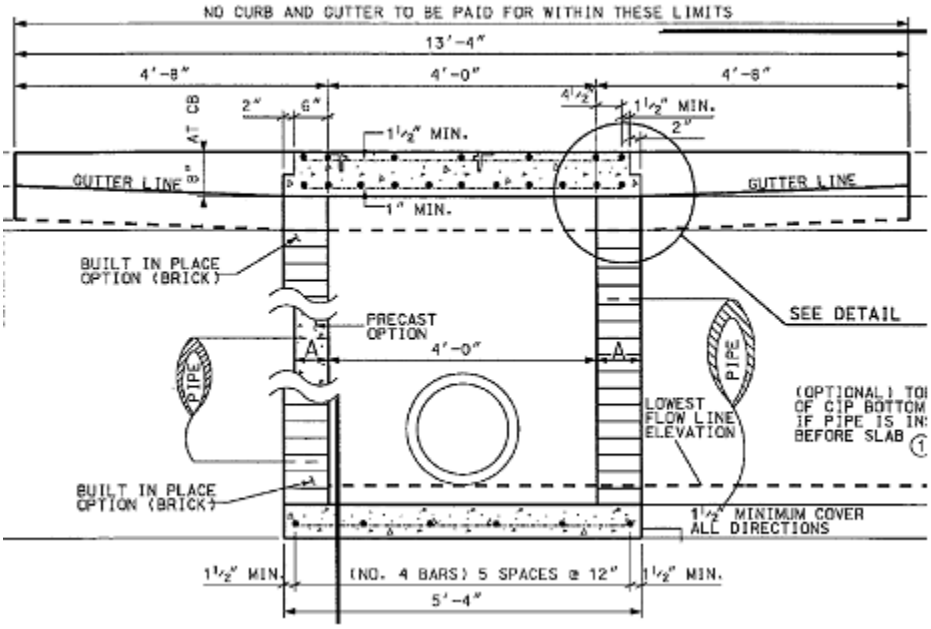


Figure 76 TYPE 16 CATCH BASIN

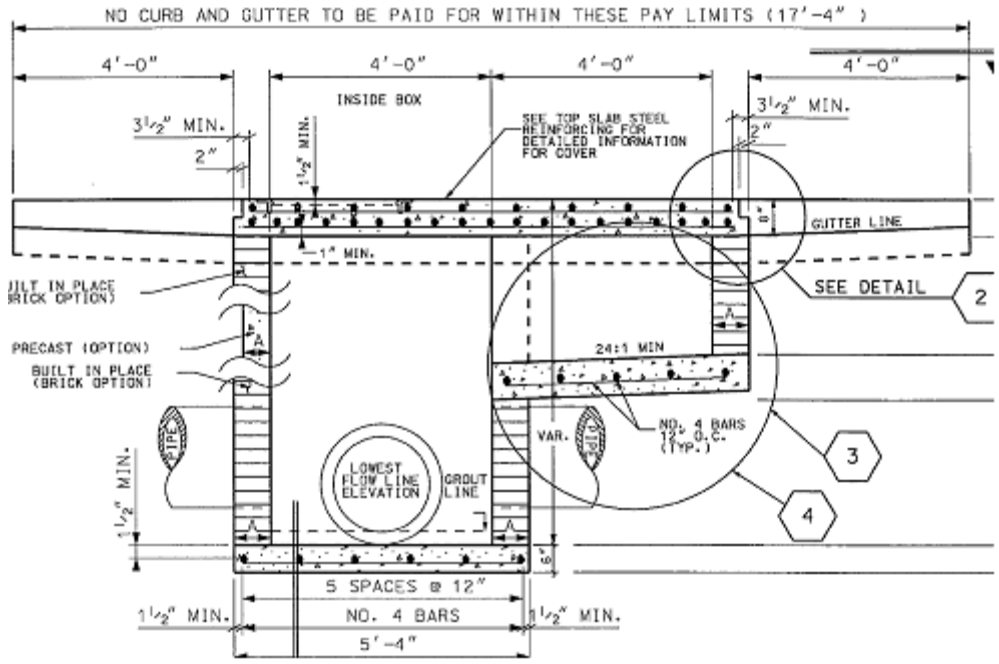


Figure 78 TYPE 17 CATCH BASIN

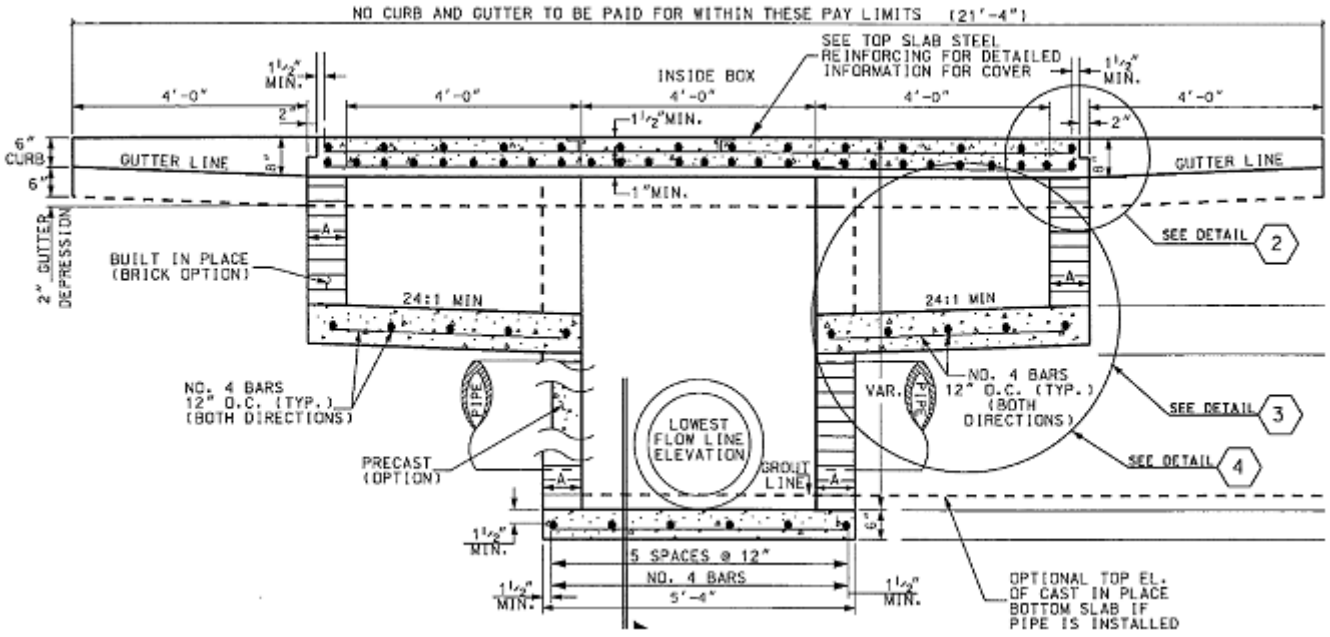


Figure 80 TYPE 18 CATCH BASIN

APPENDIX E – COMMON CURB & GUTTER TYPES

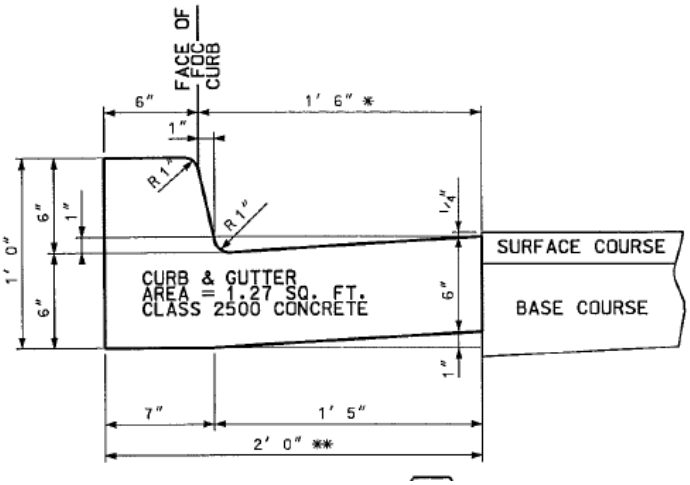


Figure 82 VERTICAL FACE CURB

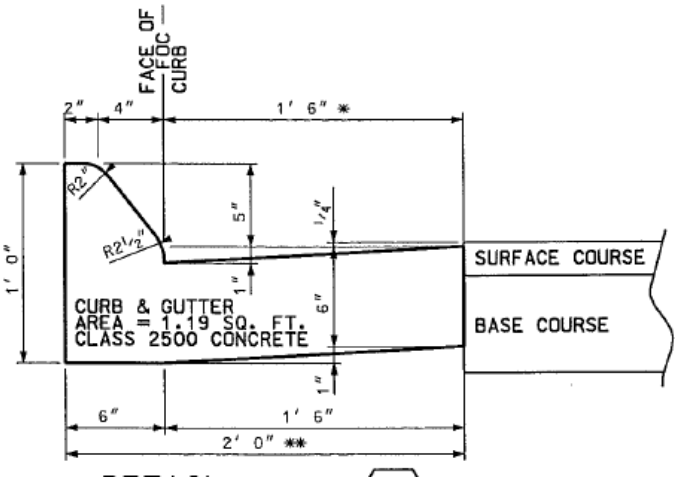


Figure 84 MOUNTABLE CURB

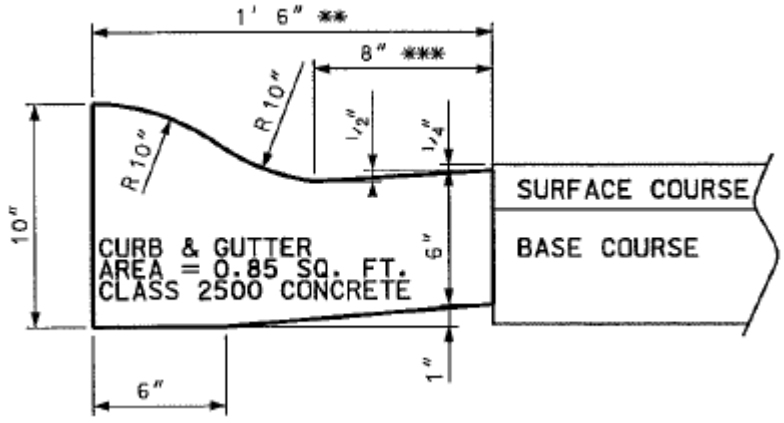


Figure 86 OGEE CURB

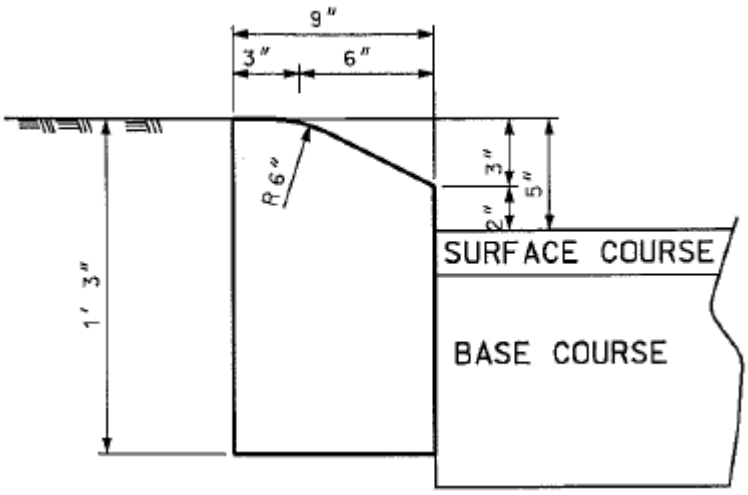


Figure 88 ISLAND CURB

APPENDIX F – RIGHT OF WAY MARKERS AND MONUMENTS

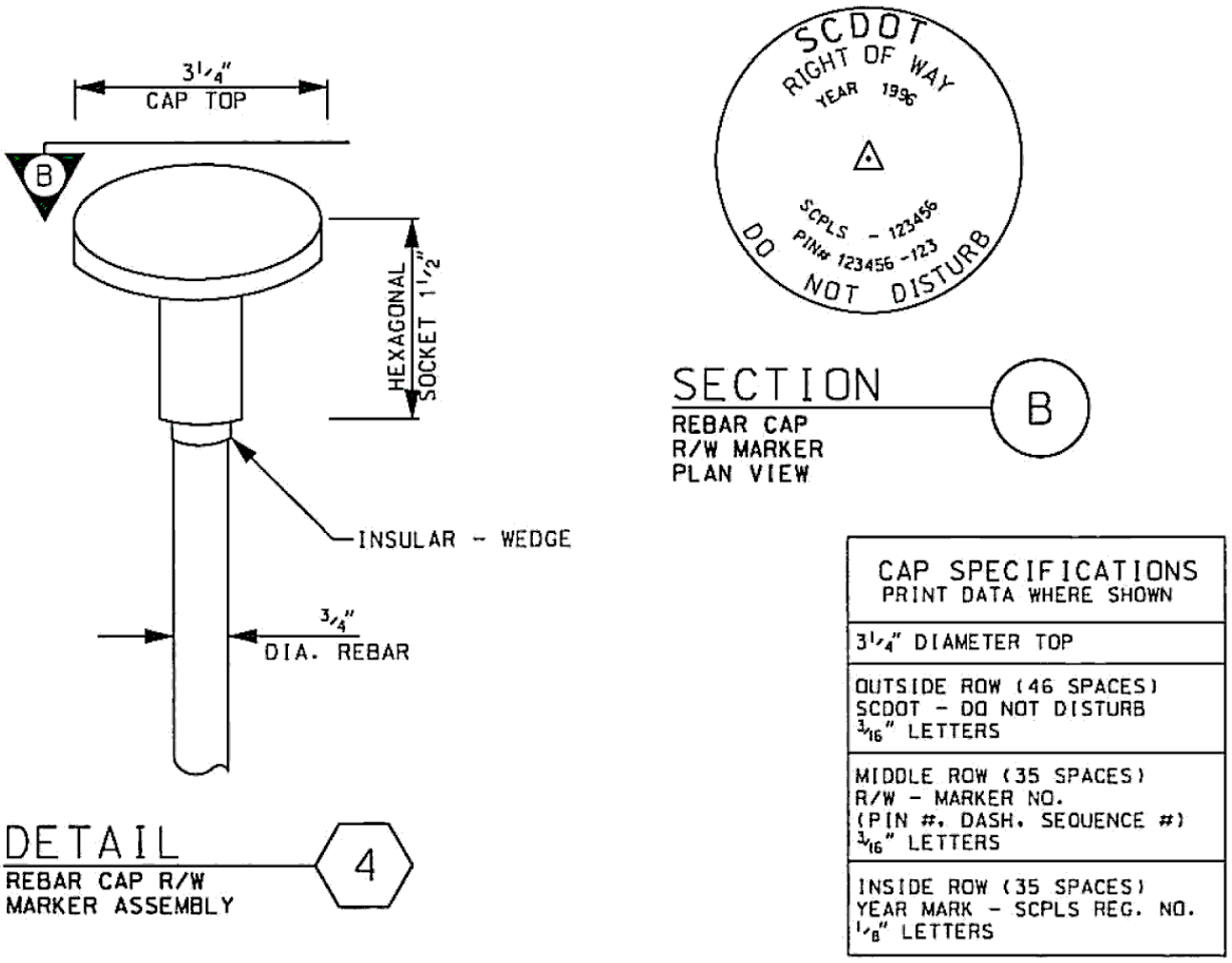


Figure 90 Right of Way Cap Detail

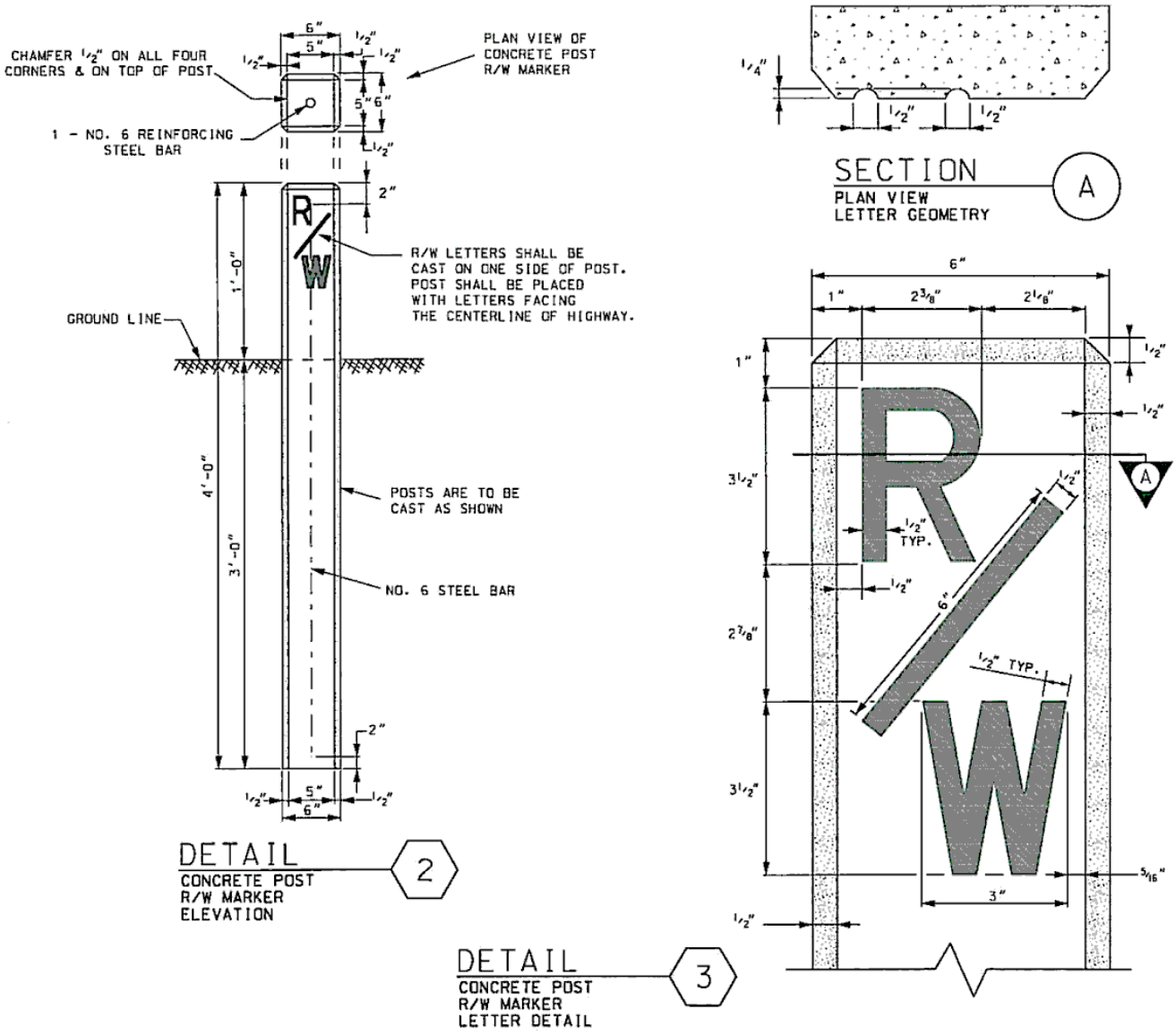


Figure 92 Right of Way Monument Detail

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